# AN OSTEOLOGICAL STUDY OF CRANIAL AND INFRACRANIAL REMAINS FROM TONGA

Michael Pietrusewsky
*University of Toronto**

*Abstract.* Individual burials recovered by archaeological excavation from two prehistoric Tongan burial mounds are described. Remains (often incomplete) of some 99 individuals are analysed where possible according to age and sex and an assessment of stature and build attempted. Morphological and some metrical data for both cranial and infracranial material, and nonmetrical data on dentition are presented. A section on palaeopathology is included. Limited comparisons are drawn between the excavated sample and modern (c. 1920) Tongans.

## 1.1.

The report that follows is an osteological (odontological) analysis of cranial and infracranial remains from two Polynesian burial mounds (To-At-1 and To-At-2) excavated by J. M. Davidson in 1964 on the island of Tongatapu (Davidson, this volume). This study was carried out during a six-week period from July 1967 to mid-August at the Auckland Institute and Museum in Auckland, New Zealand. It constituted part of a summer's independent fieldwork programme for purposes of collecting data to be used in my doctoral dissertation in Physical Anthropology at the University of Toronto.

## 1.2. ACKNOWLEDGEMENTS

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the initiation of the project and carrying out of the analysis and writing of the manuscript on return.

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### 1.3. IMPORTANCE OF STUDY AND PROBLEM ORIENTATION

In view of the parlous state of physical anthropology in Polynesia today, a skeletal collection of such size, condition and certified provenance has significant implications for all branches of anthropology.

1. The amount of skeletal material from Western Polynesia now available for research in museum and private collections is negligible. Furthermore, the usefulness of such examples as are extant is usually vitiated by lack of archaeological control which might provide temporal or spatial relationships. This new material adds appreciably to preexisting samples and, in some respects, is the sole representation of a prehistoric Tongan people. In comparison with other individual collections, this bone assemblage far exceeds any other known. In fact, its size exceeds that of all other collections put together.

2. As most other existing collections are composed almost entirely of crania and mandibles, the infracranial material now present is a most welcome addition and although fragmentary at times, exceeds both quantitatively and qualitatively other comparable holdings. Analyses of infracranial remains of any population are few and this appears to be the first for Tonga or Western Polynesia.

3. The exhumation of this material was carried out under controlled archaeological procedures.

4. At least two reliable radio carbon dates indicate that these remains represent a pre-contact people so that the presence of effects due to miscegenation may be excluded.

Although a site report and description is the primary objective, there is still a large spectrum of personal interpretation as to what a site report should and can include. The avenues of approach are numerous and the methods of analysis varied. As an anthropologist and not a human anatomist, epidemologist, human geneticist, orthopaedic surgeon, biochemist, pathologist, or any other specialized researcher *per se,* I hope, at least to touch on as many aspects of a pure osteological analysis as possible. Speaking more generally, I would like the report to serve as an integrative matrix for the physical description and its environmental domain. Nonmetrical findings will be stressed over the traditional caliper approach with emphasis on discontinuous morphology. In most instances, trait variation, dimensional differences, and palaeopathological data are compared on the basis of sexual differentiation. In some cases, however, the data will be presented on a mound basis. The reasons for presenting comparisons on a mound-association foundation is because of the uncertainty of the temporal association of the two mound groups and also the appropriateness of comparing samples by the discrete-trait method on either a time, as in this case, or on a spatial alignment. Even though individual sample sizes are small and therefore the statistical implications somewhat tentative, for presentation purposes, a morphological analysis seems more important. The data to be presented here will at least provide a basis to which the remaining unexcavated material of these two mounds might be added hopefully at a future date.

More specifically, the report will include brief descriptive notes on the individual burials, a summary of age and sex proportions and their demographic purport, a metrical and morphological analysis of the skull and infracranial skeleton, dental findings, a descriptive section on palaeopathology and, finally, comparisons.

### 1.4. METHODS

The skeletal remains were studied by one person and observations for each individual were recorded separately on a number of forms representing various regions of the skeleton. Reconstruction of fragmented material was undertaken in many instances before any observations were possible. The unscrambling of 'mixed' individuals and orientation in a supine position were standard preparatory procedures.

All metrical data and tests of significance were analysed by use of an Olivetti table-top computer and all non-metrical data were quantified by entry onto IBM punch cards and then sorted and the incidences computed by using an electronic calculator.

Definition of measurements as used in the study are to be found prefacing Appendix 1 and 2 for cranial and infracranial osteometry.

#### AGING

Spheno-occipital synchrondorsis and epiphysis-diaphysis fusions were the most important criteria in distinguishing adult-subadult skeletal remains and also in determining a more specific age assignment of the immature individuals. Ossification of cartilaginous precursory matrices as in the wrist and knee region of the subadults was also of major importance when individual burials were complete.

Of the skull, fontanelle and sutural closure and tooth eruption were valuable guidelines in determining the relative age of the individuals under consideration.

The symphysis pubis was often not able to be studied, the frequent damaging of this area made a more specific chronological assessment impossible for the adult sample. For this reason, only a 'young', 'middle-aged', and an 'aged' classification was possible. Dental deterioration and other degenerative skeletal signs were also useful in assigning individuals to these relative age categories (Krogman 1962, pp. 18-111).

### SEXING

Sexing of the subadult skeletal material was not attempted. Of the adult series cranial, pelvic, dimensional aspects of articular surfaces and lengths of long bones, and general robustness of the skeletal remains were the essential discriminating techniques employed (Krogman 1962, pp. 112-152).

In many instances it was not possible to determine sex because of paucity of the remains or because of the destruction of these vital areas. If discrepancies among the discriminating techniques were found for individual cases it was usual to grant more weight to pelvic indicators.

### OTHER

A few specimens of bones showing pathology were brought back for further study consisting of X-ray, photography, and transverse sectioning. The results of these further investigations will be discussed in the chapter on palaeopathology.

## 1.5. Descriptions of the Individual Burials from Tonga College ('Atele) Mounds

This section will contain a summary of the salient features of the individual burials presented in accordance with the appropriate mound association and catalogue designation. Observations most commonly noted are those concerning probable sex and age assignment; parts of the skeleton present; and any obvious bone pathology or trauma. Age estimation is designated (S.) when criteria from the skull were used; (D.) when the tooth eruption sequence was employed; (I.) when infracranial (usually long) bones form the basis; and (V.) when the decision was based on the degree of ossification of the vertebral components.

The slight discrepancies that may be noticed between my catalogue's assignment and those found in the archaeological notes of the site may be attributed to (1) overlapping of the burials *in situ,* (2) scrambling of individuals post-excavation, (3) fossicking, and (4) the existence of a catch-all category containing miscellaneous and uncatalogued remains.

### *To-At-1*

1-A. The skeletal remains suggest that this individual was approximately three years old (D., V.). The skull is preserved in a moderately fragmentary state, but infracranially only the vertebral column, ribs, and upper limb bones are present. Because of the fragmentary condition, measurement of the long bones present was not possible.

1-B. An infant about nine months old (V., D.). The cranial elements are well represented, but are mostly disarticulated. A few fragmented infracranial bones are present from the left side, but there are none represented post-femorally. The innominate bones and femur appeared to be charred.

2. A child of roughly two to three years of age (based on comparative lengths of long bone) represented by only a few infracranial bones, some

of which were measurable while others were not owing to damage at their proximal and distal extremities.

3. Another subadult individual of approximately two years of age (S., V., D.) with most of the major bones of the skull represented but fragmented and disarticulated although the mandible is fairly complete. The infracranial skeleton is represented but the long bones were not measurable.

4-A. An adult female whose cranial fragments have been reconstructed, resulting in several large components of the skull. The mandible was also fragmentary but morphological observations for it as well as the cranium were noted. No infracranial bones were present nor pathology of bone. The external surfaces of these skeletal remains displayed a characteristically chalk-like appearance owing to preparation procedures (washing and scrubbing) later noted for certain other individual remains.

4-B. An adult of unknown sex represented by a few long bone fragments all in a highly pathological state. With the exception of one fragment of a femur, all the bones present are from the upper appendicular skeleton. Pathology of this individual and others will be dealt with more thoroughly in a later section.

4-C. The skeletal remains carrying this designation are representative of at least one child and one small adult. The child was aged between two and seven years of age, there being only infracranial representation on which to base age estimation.

5. New born to six months of age (I., D., S.) was assigned as the skeletal age of this individual. The skull was very fragmentary and a mandible fragment and a few separate tooth buds were present. All the major long bones were represented and measurements taken.

6. A middle-aged male whose skeletal remains were quite complete except for minor losses in the hand and foot regions. Some unassociated hand and foot bones were segregated. The remains are suggestive of a very robust-looking individual. Some pecularities of the supraorbital and nasal regions were noted along with excessive periodontal disease. Arthritic changes of the long bones were scored from light to moderate degrees and several specimens of calcified blood vessels were distinguished.

7. An aged male represented quite well cranially and infracranially with some intrusion and omission in the hand and foot regions. The dentition was carious (interproximal neck caries) and osteoarthritis of long bone was graded as occurring from light to moderate in degree of severity.

8. An age assignment of six months or less was given to this individual. The skull was in a very fragmentary condition whereas the mandible was represented by only a fragment from its anterior region. A few separate anterior teeth and deciduous tooth buds were also present.

9. An adult (not old) male represented cranially by a partially reconstructed skull and complete mandible with intact maxillary and mandibular dentitions. Infracranially the presacral vertebrae were well represented

and extreme lipping, fusion, and arthritic involvement were noted in the thoracic region. The remaining infracranial skeleton was well represented except for a few major bones of the lower limb and hand and foot bones. Osteoarthritis, where studiable on the long bones, was not extreme.

10. Three individuals are represented under this catalogue number. An adult (not old) male was the major individual well represented by its vertebral column, mandible (labelled B10) and partially reconstructed skull and a few long bones of robust dimensions. Other skeletal remains labelled '1-10' were representative of a smaller adult (probably '1-11') and those belonging to a child.

11. An adult female represented by seven skull fragments, a mandible and left maxilla both with intact dentitions. A few fragmentary infracranial remains from all regions also were present for this individual.

12. An adult male whose skull lacks maxillae. Also present are mandible and a few separate maxillary teeth and many small cranial and infracranial fragments. Postcranially, vertebrae and major limb bones are present. The carpal bones show extensive osteoarthritis and the left ulna displays a healed fracture. A depression on the left parietal bone is also noteworthy.

13. An adult female having only six cranial fragments from the parietal and sphenoid components representing the skull. Many small fragments of long bone representing only a minor portion of a whole skeleton were attributed to this individual.

13-C. An adult of unknown sex represented by tarsal and metatarsal fragments was given this designation to correct its supposed association with '13' proper. These bones do not appear to belong to either individual '9' or '4' which appear stratigraphically close to '13'.

14. An adolescent of approximately fifteen years of age (D.) represented by a few cranial fragments, mandible, and maxillae fragments. Rib, vertebral and upper limb fragments were also present.

16. Newborn to six months old (possibly foetal). Tympanic development was probably in stage II (Anderson 1962a, p. 145) and the cranium was in several separate pieces. Long bones, of which some were measurable, also were particular to this individual.

17. Another infant between 0-8 months of age (older than '16') characterized as having a fragmented and incomplete skull and associated mandible and maxillae fragments. Vertebrae, ribs, and upper limb bones also were present but not completely.

18. Approximately two years of age and represented by maxillary and mandibular fragments (almost complete) and some separate deciduous teeth.

19. An adult (not aged) of unknown sex. The cranium was partially reconstructed to give a calotte with petrous part of the temporal bone plus occipital bone in addition to separate bones and fragments. Infracranial

representation was quite good except for frequent damaging of the extremities of the long bones.

19*. This 'unplaced' individual is represented by an intact cranium and first cervical vertebra.

20. An adult male (not old) of fairly robust build. The skull was in a fragmentary condition; mandible and both dentition complete. The infracranial remains include only vertebrae and fragments of vertebrae.

21-A. An adult of unknown sex represented by a highly pathological and reconstructed calvaria, right maxilla and fragments of upper limb bones. The left ulna is illustrative of a kind of pathological involvement typical of most of the surface lesions found not infrequently for this skeletal collection (see palaeopathology section).

21-B. Adult of unknown sex represented by fragments of a humerus and several lower limb bones of which the tibiae display typical pathological lesions.

22. An adolescent of roughly twenty years of age represented by a very fragmented skull. Infracranially, this individual is represented by vertebral fragments, long bones which are missing proximal and distal extremities owing to damage, and bones of the right and left feet.

23. A young female known from a partially reconstructed cranium, mandible, and complete dentitions. The presacral vertebrae are well represented but the long bones are greatly damaged.

25. A child of approximately three years of age represented by a mandibular fragment with intact deciduous teeth and a few fragmented bones of the upper limbs only.

26. A fragmented cranium, associated mandible, infracranial bones superior to the thoracic region are representative of this adult female. Decomposition of these bones was excessive and was probably due to soil acidity.

27. Apparently an adult male represented by a highly fragmented infracranial skeleton which included only a few fragments of vertebrae. The bones were greatly rarefied and fragile.

28. A child of approximately eight years of age (V., D., I.) possessing an incomplete and highly piecemeal cranium, complete mandible, and an incomplete and fragmented infracranial skeleton.

29-A. Only a few fragments are representative of the cranium of this individual and two mandibles were found with this catalogue designation. The infracranial remains are those of a robust, adult male. The left tibia is swollen and pathological.

29-B. A child, three years of age (V., D., S.), represented by mandibular, maxillary, and other skull fragments. Infracranially, this individual is represented by numerous long bones which were quite damaged.

29-C. New born to six months of age (V., D.). The cranium of this individual was highly fragmentary and the mandible was represented by only a small piece from the left side. Although damaged, the infracranial representation was quite good.

30. Only maxillae (with intact dentition) and zygomata represent this subadult Tongan whose age is placed at about thirteen years. The infracranial skeleton is represented by fragments of a clavicle and scapula.

31. This adult male is represented by only a few infracranial bones mostly from the lower limb region.

32. An age of new born to nine months is assigned to this individual, poorly represented by only skull fragments and a left humerus.

33. No specific age assignment was given to this individual except to say that it was a child, represented by only one right parietal fragment and four or five small cranial fragments. These remains may very well belong to individual '2' as might be verified by stratigraphic positioning and relationship.

34. The skeletal remains of this young adult male are in an excellent state of preservation infracranially having a reddish tinge to them. The cranium was fragmented and complete and the vertebrae were well represented, but only the left side of the appendicular skeleton was available for study.

35. An infant of approximately six months age (D., V., S., I.), well represented cranially and infracranially.

36. A two-year-old (D.) with skull well represented but disarticulated.

37. Only one cranial fragment of the right parietal bone represents this child of seven or eight years of age. The infracranial skeleton is well represented although damaged.

38. An infant assigned an age of nine months.

## *To-At-2*

1-A. The skeletal remains are those of a child three years of age with most of the bones of the cranium present, but disarticulated, and associated mandible and complete dentition. Most of the long bones are present with the notable exception of the left femur, tibiae and foot bones.

1-C. A small female of middle- fringing on old-age with most of the facial and anterior basal elements of its skull missing. Mandible and complete dentition are present with the maxillary teeth showing marked caries. The infracranial skeleton is missing all bones inferior to the pelvic region. The right radius and ulna show distinct evidence (external) of a poorly healed fracture.

1-D. The metacarpal epiphyses of this individual have just fused to their diaphyses whereas the condylar epiphyses of tibia and a femur are still separate. In all, this adolescent of approximately sixteen years of age is represented by a right fifth metacarpal, tibiae, fibulae, and femur fragments.

1-E. At least four individuals are designated '1-E'

(1) A child of three to four years of age is represented by a fragment of the left mandibular half and left maxillae both with intact deciduous dentition.

(2) The right and left maxillae and complete mandible are representative of an adult male.

(3) A small adult is represented by complete maxillae.

(4) An adolescent (seventeen to eighteen years of age) was sorted out as having a complete vertebral column, highly fragmented scapulae, humeri, innominate bones, manubrium, and sternebrae elements particular to its skeleton.

2. This infant possessed an unfused metopic suture and was assigned an age between new born and six months (V., S.). A fragmentary and incomplete cranium and damaged right mandibular half characterize the skull. Measurement of the major long bones was possible.

3. A child of approximately six years of age with cranial elements well represented but disarticulated and somewhat fragmented. A damaged mandible and maxillae with deciduous dentition were also present. Infracranially, this skeleton was represented by only a few rib fragments and by its first cervical vertebra.

4. The skull of this very tall and robust individual was not available for study and its very complete infracranial remains are thought to represent a person of middle-age characterized as a female primarily on the basis of pelvic conformation. A congenital absence of a thoracic vertebra (first) is certain as well as a fracture in the distal third of the right ulna in addition to pathology of the sternal extremities of the first ribs which will be noted further later.

5. This individual is tentatively assigned as an adult male and is especially notable in having its right and left foot bones (along with numerous sesamoid bones) well represented and fibular fragments, which are pathological, present.

6. A fairly robust, young male with cranium and mandible in a fragmentary but reconstructable condition. The infracranial remains are scanty; there being only a few bones of the shoulder girdle and thoracic regions present along with some bones from a right hand.

7. With the exception of hand and foot bones, the remains of this child between the ages of one and two years (V., D., S., I.) are complete and in excellent condition.

8. The bony remains comprising tibiae, talar and metatarsal bones are probably those of a robust adult male.

9. The skull and upper infracranial skeleton of this two-year-old (V., D., I.) are fairly complete.

10. All bones of this individual are from the lower limb regions comprising a highly fragmentary and incomplete assemblage of this adult of unknown sex.

11. An adult (23 years of age) female with complete skull missing only facial elements and infracranially well represented down to and including the femora.

For cultural reasons, this image has been removed.
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FIG. 1—A lateral view of the skull of To-At-2-13, a middle-aged male.

13. A complete skull (Figs. 1-3) and long bones from the upper limbs are all that remain of this middle-aged male. Slight osteoporosis of the supraorbital region and some other pathological disorders of the skull were observed as well as extreme osteoarthritic lipping and erosion in the cervical vertebrae.

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Fig. 2—Frontal aspect of To-At-2-13's skull.

13-A. This individual was very similar to '13' in general morphology being also a robust middle-aged male with complete skull and the infracranial skeleton fairly complete to about the ninth thoracic vertebra.

13-C. An adult (fairly robust) male represented by femora shaft fragments and one tibia mid-shaft fragment.

14. An age of new born to one year (V., D.) has been ascribed to this nearly complete infant skeleton.

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FIG. 3—Posterior view of To-At-2-13's skull.

15. A 15-year-old adolescent (metatarsal epiphyses still unfused) represented only by tibial fragments and pedal bones.

16. Only a fragmented mandible is present for this young adult female infracranially represented by the upper limb skeleton.

17. This infant (new born to two years of age) is well represented infracranially but there are no cranial bones available for study.

18. The bones of this old adult male are generally arthritic. Of the skull, only a reconstructed calvaria and fairly complete mandible remain. In the teeth present caries are prevalent, and two proximal phalanges of the right hand show possible healed fractures.

19. A male (twenty-two to twenty-three years) represented only in the pelvic and lower limb region (lacking pedal bones) except for the inclusion of a few bones from the right hand.

19*. No catalogue number was given to this nearly complete cranium which is believed to be an adult (not old) male and possibly belonging to '19'.

20. The lower limb bones are all that remain of this adult female. Two intrusive femoral shaft fragments were also noted.

21. Another adult female represented also by only the lower limb skeleton.

21-B. A child of approximately five years of age (V., I.) is here represented by innominates, femur, vertebrae, ribs, and hand bones.

22. The robustness of the skeletal remains of this individual lend credence to its assignment as an adult male. Only skeletal remains from the lower appendicular and left hand are present.

22-A. Another adult male (slightly less robust than '22') infracranially represented by the lower limb (tibiae, fibulae, and foot) skeleton.

23. Bones and fragments of the lower limb skeleton are all that were available for study of this adult of unknown sex.

24-A. A small adult female characterized as having a fragmented and incomplete skull. Best representation of the bones of the infracranial skeleton was in the vertebrae.

24-B. Another small adult (middle-aged) female much like '24-A' in its incomplete skeleton.

25. The skull of this adult (not old) female consists of two major reconstructed pieces and a few separate cranial fragments and complete dentition. The vertebral column is in excellent condition and present from the first cervical to the tenth thoracic vertebra inclusive. Humeral, scapular and clavicular fragments are also present.

26. An adult female of which no cranial or mandibular bones are present. Bones of the infracranial skeleton are incomplete, but in an excellent state of preservation.

27. Two mandibles are assigned this catalogue number; one fragmented and the other complete, as well as a broken and incomplete cranium. Infracranially, this adult female is represented by bones of its appendages and vertebrae.

27-A. This adult female is not associated with '27' as cataloguing suggests, and is represented by infracranial bones only.

28. An adult female fragmented skull with only the mandibular dentition present. These remains may belong to '29' which was not located as described in the archaeological field notes.

30. No cranium but two mandibles (one complete and the other only a fragment of a left mandibular half) were found to denote this adult female sporadically represented by various bones and fragments of the infracranial skeleton. Some intrusion and mixture with another individual as well as fragments of non-human bone were also found.

31. A reconstructed and incomplete calvaria and associated mandible and some infracranial bones represent this young adult male. Of particular note is the presence of an *os inca.*

32. The cranium of this adult female is represented by only a few bony fragments and a complete dentition. All upper and lower limb bones are greatly broken and soil-eroded.

33. This young adult male has skeletal remains comprising a reconstructed calvaria, mandible, and a fragmentary and incomplete infracranial skeleton.

34. An adult of unknown sex, having tibiae, fibulae and femoral fragments in addition to talar and metatarsal bones available for study.

35. Another adult of unknown sex, represented by bones and fragments of the lower limb skeleton only.

36. Mandible and maxillae denoting a child of approximately four years of age (D.).

37. Fragmented pedal bones and fragments of the left tibia and fibula were appraised as those of an adult of unknown sex.

38. Fairly complete left and right foot assemblages (no phalanges) and one left fibula missing its proximal portion comprise this adult (male?) individual.

39. This juvenile of less than fourteen years of age is represented only by pedal bones; the metatarsal and phalangeal epiphyses are as yet unfused.

40-A. An old adult female is here represented by a reconstructed and incomplete calvaria, complete mandible and an infracranial skeleton composed of the upper limb and upper axial regions.

40-B. The mandible and maxillae with fairly complete dentition of an adult of undetermined sex.

41. A partially reconstructed skull, edentulous (premortem) mandibular and maxillary fragments, and an incomplete and fragmentary infracranial skeleton denote this individual as an old adult male. Also found in this particular bone assemblage were fragments of long bones of a very small adult or an adolescent and some non-human skeletal remains (turtle?).

42. An adult male found to have a mandible and separate maxillary teeth, and infracranial representation down to the mid-femoral region. All the bones, with the exception of the humeri, were quite fragmented.

### *Miscellaneous skeletal remains studied*

The entries listed here are all uncatalogued and it was not possible to decide to which of the above individuals and/or other individuals they should be assigned.

CRANIAL

| Assigned Cataloguing | Description | Sex | Age (Adult) |
|---|---|---|---|
| MS1 | Skull | Male | Old |
| MS3 | Skull | Female | Old |
| MS4 | Skull | Female | ? (not old) |
| MS5 | Skull | Female | Old |
| MM1 | Mandible | ? | ? |
| MM2 | Mandible | ? | ? |
| MM3 | Mandible and Maxillae | Male | ? |
| MM4 | Mandible and Maxillae | ? | ? |
| MM5 | Mandible and Maxillae | Female | ? |
| MA1 | Maxillae | ? | ? |
| MA2 | Maxillae | ? | ? |
| MA3 | Maxillae | ? | ? |
| MA4 | Maxillae | ? | ? |

INFRACRANIAL

No catalogue designation was given to these numerous bones and fragments which were not assigned to a specific individual. A short summary of most of these miscellaneous bones follows:

| Bone | Complete | Fragmentary | Adult | Subadult |
|---|---|---|---|---|
| Clavicle | 2 | 9 | 10 | 1 |
| Humerus | 3 | 12 | 14 | 1 |
| Radius | 2 | 7 | 8 | 1 |
| Ulna | 2 | 8 | 8 | 2 |
| Femur | 1 | 16 | 15 | 2 |
| Tibia | 6 | 4 | 10 | 0 |
| Fibula | 1 | 8 | 9 | 0 |
| Sacrum | 3 | 0 | 3 | 0 |
| Innominates | (7 ilium-ischia, 4 ischia, 5 ilia) | | | |

### 1.6. Sample Size, Age and Sex Proportions

Remains of the two mound samples under consideration are representative of about ninety-nine individuals (46 from To-At-1 and 53 from To-At-2); because of the sizable uncatalogued and miscellaneous category, a more exact enumeration was not possible. Close adherence to the archaeological record makes my estimate a safe one, not greatly differing from the number of individuals said to have been excavated.

Tables 1 and 2 assign each individual to an age category as well as a sex designation in some cases. A summary of adult and subadult age-groupings is presented in Table 3 according to mound association.

The sample from To-At-1 reveals an excess of subadults (52.2%) over the adult representation, with the highest incidence (37.5%) of deaths occurring before one year of age, contrasted to To-At-2 where there is a predominance of adults (73.6%). However, it is of note that the majority of the subadults from To-At-2 are under four years of age. This disparity in age-group proportions might be the result of a number of factors alone or in conjunction: (1) a high infant mortality rate; (2) selective (conscious or unconscious) use of the burial site; (3) absence of much of the adult population at time of mound construction; (4) non-random deposition of burials within the mound; (5) a cultural practice such as interment of a sacrificial infant relative with an adult burial. To-At-2's age-group proportions may be attributed to negative or similar inferences made for To-At-1's alleged disproportionality or they might resemble the normal state of age-group proportions at death.

Since a fairly reliable cross-section of each mound was obtained, these age-group proportions are most probably a true picture of the entire structural mound entity. Secondary abstractions as to whether these samples are representative of a particular cultural or biological unit using these mounds as cemeteries is speculative as well as broader inferences regarding representation of the entire island of Tongatapu.

Mound To-At-1 may be broadly divided stratigraphically into an earlier and a more recent period. Less than half of the earlier burials were subadult, whereas more than half of the recent burials were of subadult status. There were few cases of immediate contemporaneous juvenile burying and many instances of highly disturbed infant deposition at the foot of adult burials.

Only two of the fourteen subadult burials of To-At-2 mound can be assigned to either an early or middle period of construction with the remaining twelve being deposited amongst the youngest interments and a number of these added very near the surface apparently in an unceremonious manner.

These added findings reveal a trend toward increased infant or subadult mortality. If pathological inferences are to be invoked, the skeletal remains do not seem to be of assistance in deciding an aetiology, as no inflammation or other evidence of bone pathology was found on gross inspection. Many of the infant burials appeared to be in good order and in an excellent state of preservation. As diseases which affect bone or come to affect bone are only a small minority of the total spectrum of pathologies, other disorders cannot be ruled out as causal from my negative evidence.

Because of the uncertainty (in many cases because of the incompleteness of the skeleton) of assigning a sex to each of the adult individuals, a sex ratio estimation is not practical, but three categories of sex according to mound membership are presented in Table 4. Visual inspection of assigned sex (male or female) reveals the incidence of males in To-At-1 as being twice as prevalent as females whereas To-At-2 has equal representation.

In summary, Mound To-At-1 appears to have atypical representation both in its age-group and sex proportions. To-At-2 appears more equally proportionate, with a temporal change of increased subadult mortality being experienced by both mound samples.

## 2. THE CRANIUM

### 2.1. General

A metrical and morphological study of the skulls was undertaken and will be presented in a regional format. The measurements taken and individual values are presented in Appendix 1 of this report, and mean values for male and female specimens are tabulated in Table 12. Adult cranial variations (both discrete and continuous) are presented in table form and incidence values will most often refer to adult cranial morphology with special instances of lumping of subadult and adult values where this was felt to be permissible.

### 2.2. Facial Morphology (Tables 5, 10, and 12)

Facial indices (Table 12) were calculated for only male representatives and are based on a small sampling. A range from 93.4 to 98.2 was arrived at for the gnathic index (Appendix 1 and Table 12). Euryenic (48.1) values were obtained for upper facial indices, and high readings (116.5) of hyperleptoprosopy were found for the total facial height (Table 12).

The orbital index (Table 12) for males ranges from extreme microseme (69.6) to low mesoseme (83.0) whereas the nasal aperture may be referred to as mesorrhinic, but with individuals ranging from leptorrhinic to platyrrhinic in this shape-value relationship.

The predominant form of the very few intact nasal bones was "hourglass shaped". A "blurred" effect was most often found to be descriptive of the subnasal region, other designated possibilities being "groove", "sulcus", or "sharp-line". This nondescript, smooth, moulded appearance was thought sometimes to be attributable to old-age and/or diseased state; these degenerative specimens automatically being lumped here, as well, when not strikingly pathological (Table 5).

No cases of "full metopic suture" were noted for the adult series, but a 62.5% incidence of a "persistent on brow ridge only" was found (Table 5) as compared with a 66.7% incidence for the subadult series (Table 10).

Bossing of the frontal bone most often was bilateral (60.9%) and only one instance of frontal grooving (4.3%) was found, occurring bilaterally in that case (Table 5). No frontal grooves were observed on subadult material (Table 10).

The supraorbital structure for transmitting nerves and vessels most often took the form of a spurred notch on both right and left sides with foramina occurring only half as frequently for the total series (Table 5). A single foramen was more often found in the subadult sample than the spur formation (Table 10).

"+V" brow ridge form was noted as most common in the adult population as a whole with females more often (87.5%) displaying a "++V" formation than males (Anderson 1962b, p. 111). This apparent sexual dimorphism may also explain the difference found when comparing mound incidences for this trait (Table 5).

Double infraorbital foramina occurred on both left and right sides with no striking sex difference or mound difference being observed (Table 5). This structure took the form of a single foramen in most subadult cases (Table 10).

No case of *os japonicum,* a horizontal suture dividing the zygomatic bone, was found in adult or subadult samples. A mound or lump on the anterior surface of the zygoma is here referred to as "malar tuberosity" and was scored on a 0, +, ++, +++ basis. It was found that a small incidence of 18.8% and 15.4% for the right and left respectively was present and confined to those individuals designated by me as male (Table 5). This trait was also observed in the subadult material (Table 10).

The "zygomaxillary tuberosity" of the inferior surface of the zygoma was scored also on a relative basis with about two-fifths of the specimens showing a "+" degree of muscle attachment; the higher incidence found for males was as expected (Table 5). Scoring of this trait on subadult individuals is speculative, but a relatively high incidence of some degree of expression was recorded (Table 10).

### 2.3. Basal Aspect (Tables 6, 10, and 11)

Only one case of palatine torus, a bony medial elevation of the palate, was noted for eighteen adult and four subadult potential and studiable specimens (Tables 6 and 10).

The sphenoid bone was usually not studiable, but of the seven right and twelve left sides observed, no unusual condition of the ovale-spinosum foramina complex was recorded. This was the case for the subadult individuals as well (Tables 6 and 10).

One case of a "precondylar tuberosity" (9.1%) and one instance of a "double precondylar tubercle" (9.1%) were observed for the adult sample (Table 6).

Ossified apical ligament formation was of low occurrence (9.1%). Paramastoid processes occurred in five of the eleven male skulls and were the only instances of this trait (Table 6) except for a unilateral expression on one subadult (Table 10).

The hypoglossal or anterior condylar canal was divided in 15.4 per cent cases of examined skulls (adult and subadult—Table 11) with no instance of an assigned female possessing one. No case of doubling was found for the five subadult skulls observed for this trait (Table 10). Posterior condylar canals were found more often in males (70.0%) than females (40.0%) with no differences in mound occurrence (Table 6). Of two subadult skulls, one showed bilateral expression of this trait, giving an overall incidence of 55.6 per cent for all studiable remains (Tables 10 and 11).

The occipital condyles were most often single (R1L1), oval and of convex structure (61.9% of adult and subadult cases—Table 11).

### 2.4. INTERIOR (Tables 6, 10, and 11)

On the interior of the skull, the course of the groove for the superior sagittal venous sinus was felt (*lit.*) to have veered to the right (79.3%) more often than it veered to the left (10.3%) or provided a common connection for the transverse or lateral sinuses (10.3%—Table 11).

### 2.5. VAULT (Tables 7 and 12)

The crania are largely mesocranic (M. 78.3, F. 77.1) fringing on brachycranic, with individuals ranging from dolichocranic to ultrabrachycranic (91.4). Using Lees' formula for computation of cranial capacity from length, breadth, and height values, a megacranic value (1514.2) is obtained for males and a comparable one (1311.7) for females taking the expected sexual difference into account. Both means are of an aristencephal category according to Sarasin (Martin 1957, p. 376). However, the range is again quite large for the male specimens (1371.8-1710.5) and high units of standard deviation are to be noted. Length-height and breadth-height indices reveal upper range values denoting hypsicranic and acrocranic respectively (Table 12).

No wormian bones were found along the coronal or sagittal sutural areas of adult or subadult specimens. Along the lambdoidal suture, however, 39% of the adult skulls showed one or more of these accessory bones. In only one case in twenty-three (4.3%) was an *os inca* (Fig. 4) or unfused superior portion of the squamous part of the occipital present. An obliteration or fusing of a once anomalous sutural line of this region was also scored as a "trace" for one individual (Table 7).

Sagittal keeling was scored on a 0, +, ++, +++ basis and this median elevation of the vault was quite common at the "+" degree of expression (77.3%). Parietal bossing was very pronounced with an incidence of 100%, with most cases being of the "++" variety and more pronounced at this degree amongst males. Bossing of this type was also observed in subadult material (Tables 7 and 10).

Parietal foramina were either absent or single with almost equal incidence being found for right and left (R 69.6%, L 65.4%—Table 7).

### 2.6. LATERAL (Tables 8, 10, and 11)

No cases of marginal tubercles along the lateral borders of the zygoma were observed (Tables 8 and 10).

The formation of sutures at the pterion was most often fused, making observations impossible. Parietal notching was about as frequent on the right side as on the left, and one case of "parietal notch bone" was found; it occurred on the left in adult material. No cases of parietal notching were observed in the subadult material.

Accessory bones at the asterion were found in 31.3% of the adult skulls or 29.4% of all skulls (Tables 8 and 11).

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FIG. 4—To-At-2-31. A superior view of the calvaria showing an *os inca* and osteoporosis of the parietal and occipital areas.

The occiput was varied in its expression with "mound (M)", "ridge (R)", "mound-ridge (M-R)", and "ridge-inion (R-I)" being the four main categories of description. Of these, the "ridge-inion" type was most frequent (50.0%), the others occurring approximately equally (Tables 8 and 10).

Mastoid processes were generally large or at least of a hanging, pendulant structure.

Notching of the posterior margin of the mastoid process occurred in 32.1% of the adult specimens (28 skulls) and in none of three subadults (Tables 8 and 10).

Of the tympanic region, thickening and perforation (dehiscence) were infrequently encountered (14.3% and 7.7% of the skulls respectively). "Auditory exostoses" were frequent (40.7%) and were most often extremely nodular at times occluding the auditory meatus (Table 8). No thickening or perforation was found for child skulls and a 25.0% (2/8) incidence of auditory exostoses was noted for these individuals (Table 10).

## 2.7. MANDIBLE (Tables 9 and 10)

The mean values for mandibular measurements are to be found in Table 12 and individual measurements in Appendix 1.

Chin form was broadly classified as (M)—median (tapered to midline); (B)—bilateral (squared), and in combination with (A)—an arch angularity or "tenting" (Marshall and Snow 1956, p. 416) of the inferior border at the symphysis menti when viewed anteriorly. The six resulting categories appear to occur in equal frequencies, but with an apparent sexual dimorphism of the median form, as females have an incidence of 50.0% while males have an incidence of only 5.9%. In retrospect, angularity of the inferior borders was seemingly prevalent.

*Torus mandibularis* or bony outgrowth of the lingual surfaces of the mandible had a low incidence (5.7%). No tori were observed on the eleven subadult mandibles.

Gonial eversion was as frequent as gonial inversion, occurring in approximately one-third of the mandibles.

Bridging of the mylo-hyoid groove, on the interior surface of the ascending ramus, was found to occur only in an exaggerated form ("distal"), there being a long tunnel formation covering the nerve before its emergence inferiorly. No bridging was found among the subadult material.

There was only one instance (left side) of an adult mandible showing multiple mandibular foramina. Of thirteen subadult mandibles, two possessed multiple mandibular foramina.

Multiplication of the usually single mental foramen occurred in 17.1% of the adult mandibles examined (35). An incidence rate of 16.7% was recorded for subadults having this trait.

"Rocker jaw" (Fig. 5) occurred in males and females almost equally and was most often scored as "full" rocker jaw. An overall incidence rate of 67.6% was arrived at for "full" rocker and 8.8% for "slight" rocker. The "slight" category refers to unequal pivoting of the convex inferior borders usually rocking only when deflected at either the anterior (symphysis menti) or posterior (condylar) regions. A "full" rocker rocks evenly no matter where it is depressed. Eighty-three point three (83.3) per cent of the subadult mandibles showed this trait and usually of the "full" type.

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FIG. 5—To-At-2-1-C. "Rocker mandible" and maxilla; teeth showing buccal neck caries and calculus build-up.

Coronoid : condyle projection relationship revealed 56.5% of the mandibles showing equal heights attained by both processes and 30.4% having the coronoid process moderately exceeding the condyle's height.

### 2.8. SUMMARY OF SKULL

Tests of significance are largely unwarranted for the present findings without additional correction formulae being invoked. Chi-square testing was faintly justified in only two instances; the "Rocker jaw" trait and "coronoid : condyle relationship". For these two traits no significant difference was found for either male/female or Mound To-At-1/Mound To-At-2 differences.

A selected grouping of adult and subadult cranial variation incidences is presented in Table 11 as being representative of a totalled sample. Most of these variations are of a discrete nature making age differences less operative.

The crania were generally large well-rounded incasements possessing large parietal bosses, spurred supra-orbital notches, "V-shaped" brow ridges, plural infraorbital foramina, "hour-glass-shaped" nasal bones, a "blurred" subnasal region, posterior condylar canals, pendulant mastoid processes, accessory bones of the lambdoid suture, slight sagittal keeling, single parietal foramina, sutures often fused or in the process of fusing, "ridge-inion" occiput, and frequent "auditory exostoses".

The mandible was most often a "Rocker jaw" with various chin forms and arching of the inferior border a frequent feature.

## 3. DENTITION

### 3.1. General

An analysis of the maxillary and mandibular dentitions, though not attempted in detail, was not entirely neglected. The teeth, in most instances, were treated as a sample representation of a population (i.e., breeding unit) and in only a few cases will a specific individual be discussed, e.g., in presenting morphologically atypical manifestations. My analysis was directed to nonmetrical observations of the teeth and an appraisal of the dental health as inferred from the adult individuals at my disposal; no measurements being taken. More specifically, the morphological investigation was limited to mandibular molar fissure patterns, shovelling of the incisors, congenital absence, peg-shaped teeth, relative molar size progressions, and any other dental anomalies observable on gross inspection of teeth intact in their alveolar moorings. An assessment of dental health was based on the incidence of caries and alveolar abscesses present, attrition, premortem loss of teeth, and periodontal disease of the alveolus.

### 3.2. Methods and Number of Teeth Studied

Analysis of all dental observations was accomplished by entering the data on IBM cards (one per individual) and then sorting each column of the total adult sample which designated a specific trait or observation made. Totals (*n*) for the different observations will vary according to those areas which were studiable (i.e., intact and undamaged).

A maximum of 485 teeth of the maxillary dentition and 596 teeth of the mandibular dentition were studied representing 36 maxillae and 39 mandibles respectively. A breakdown as to specific tooth groupings can be estimated from Table 15.

### 3.3. Dental Morphology

#### MANDIBULAR FISSURE PATTERNING (Table 13)

Six categories were found to characterize most generally the fissure patterns of the mandibular molar teeth of the present sample under consideration. These particular configurations are summarized as to their frequency of occurrence according to sex in Table 13. "+" patterns refer to cruciate grooves separating the cusps, whereas "Y" patterns have their mesio-lingual and disto-buccal cusps in contact (Anderson 1962b, p. 95; Dahlberg 1963, p. 170). "Crenulated +5" refers to a basic "+5" pattern with varied crenulations superimposed, whereas the "wrinkled" classification denoted a nondescript but highly crenulated pattern.

The first molar most often displays the "+5" pattern more frequently on the right side with an incidence of 64.7% for the total series. There is a higher occurrence in males than in females. Both sexes show a decidedly higher incidence rate of the "Y5" (so-called Dryopithecus pattern) on the left molar and an incidence of 26.5% for the entire series confined exclusively to the left side.

M2 is most often characterized as having the "+4" pattern occurring (72.1%) with the "+5" being the next most common type. A sex difference does not seem to be present nor is a side dissimilarity evident.

Third molars are similar to the first as the "+5" pattern is again prevalent with wrinkling occurring in 20.6% of the total series. Sex and side differences do not seem to be of importance or at least not predictable from the frequencies here observed.

"Crenulated +5" and wrinkled patterns were confined to the third molars.

### SHOVEL-SHAPED INCISORS (Table 14)

No shovelling was observed in the 150 lower incisors. The trait was scored as either a "slight shovel" or "full shovel" for the 87 maxillary incisors inspected. The frequency of occurrence of any kind of shovelling on the lateral and central incisors was about equal with a marked sex difference as the females in each case possessed a higher incidence. A slight preference for central incisors over lateral incisors was also noted. Twenty-five point three (25.3) per cent of all incisors of the total adult series showed some kind of shovelling (see Table 14). These results are comparatively low for values cited by others for all Polynesia (Riesenfeld 1956, p. 513).

### MOLAR SIZE PROGRESSION (mandibular)

In most cases the size progression: M1> M2> M3 was found to be typical with a slight tendency toward an equalization occurring distally and then encompassing the total molar group as the table below depicts.

| | Number | | | | Percentage | | | |
|---|---|---|---|---|---|---|---|---|
| Size progression | M. | F. | ? | T. | M. | F. | ? | Total % |
| M1> M2> M3 | 6 | 5 | 10 | 21 | 75.0 | 71.4 | 90.9 | 80.8 |
| M1> (M2=M3) | 0 | 1 | 1 | 2 | 0.0 | 14.3 | 9.1 | 7.7 |
| M1 = M2 = M3 | 2 | 1 | 0 | 3 | 25.0 | 14.3 | 0.0 | 11.5 |
| *n* | 8 | 7 | 11 | 26 | | | | |

## 3.4. ANOMALIES AND OTHER MORPHOLOGICAL VARIATION

### PEG-SHAPED MOLARS

Two cases of diminution in size or pegging were observed. Individual *To-At-2-25* possessed what might be more properly termed a "reduced" molar, resembling any other molar in general morphology except that it was only about half the normal size. In this instance it was the left lower third molar. Extreme attrition and periodontal disease in addition to buccal abscesses were also noted for this individual along with exaggerated spacing of the teeth in both dental arcades.

The other case was a peg-shaped upper right third molar of a maxilla tentatively labelled *"MA2"*, as evidenced by its alveolar socket, the tooth being lost portmortem.

### MESIAL ROTATION

At least three notable cases of mesial rotation or "winging" (Dahlberg 1963, p. 156) were observed. Individual *To-At-2-32* displayed unilateral rotation or winging of its lower right central incisor whereas *"B10"* had all four of its lower incisors obliquely set; each markedly counter mesially inclined. Individual *To-At-1-7* also displayed a rotated lower right lateral incisor.

### CONGENITAL ABSENCE

The following individuals are thought to have congenital absence:
*To-At-1-7*. On gross inspection it is believed that the lower right central incisor of this individual was congenitally absent.
*To-At-1-11*. The lower left M3 of this specimen is believed never to have been present.

*To-At-2-42*. Hypodontia in this individual is demonstrated by the observed absence of the lower right lateral incisor.

As the above conclusions were made only on gross observation and without the aid of roentgenograms, their status as congenital absences is fairly tentative.

### OTHER

*To-At-2-27* was observed to have an accessory cusp distally placed on its lower left M3.

*To-At-1-20*'s upper right central incisor showed a heaping up of its distal margin resulting in a pimple-like structure.

## 3.5. Postmortem and Premortem Tooth Loss (Table 15)

The incidence of postmortem loss of teeth in a population sample might provide an index to the structuring of the alveolar borders holding the teeth intact or, more likely, an indication of the amount of disturbance and handling after death and/or burial of the individual. Whatever reasons might be postulated, incidences of premortem and postmortem tooth loss have been tabulated for each tooth group in Table 15. As is most often the case the incisors are the most frequently dislodged with a progressive decrease distally into the molar series.

Premortem loss will be indicative of pathological, traumatic, and cultural factors experienced before the death of an individual. In the present adult sample, the lower molars were most often not present before death with a 20.8% incidence of loss. The remaining series seem to oscillate around a general mean of much lower incidence with an 8.7% value being calculated for the entire sample; a low value.

## 3.6. Attrition (Tables 16 and 17)

Attrition was scored on a "none", "slight", "blunted cusp", "dentine exposure", and "pulp exposure" basis on complete (or almost complete) maxillary and mandibular dentitions. Differences between sexes do not appear to be evident nor can it be generally held that this particular sample is typical as having experienced extreme wearing of its occlusal surfaces. The incidence of attrition for anterior and posterior regions of the maxillary group are quite constant with a "slight" to "medium" amount of wear being evidenced in relative terms as a whole.

The attrition observed for the mandibular set is somewhat marked with the posterior region showing a slightly higher incidence over the anterior group.

### 3.7. DENTAL PATHOLOGY (Tables 18, 19, 20)

The incidence of the various types of caries found in the entire series of complete permanent dentitions of adults of both sexes was quantified as is shown in Table 18. Caries were categorized as either "buccal neck", "lingual neck", "interproximal (neck)", "deep occlusal", or "pit".

"Buccal neck caries" occurred most frequently while "lingual neck" and "deep occlusal" types were the least frequent. Neck caries were by far the most prevalent type, occurring almost twice as often as any occlusal type.

A total incidence of 8.3% for all types of caries for all teeth examined may be said to represent this sample with only a slight difference being cited for upper and lower dentitions.

Table 19 presents frequencies of all types of caries for each tooth group (upper and lower combined) which points to the greatest amount (13.2%) of involvement in the molar teeth with canines, premolars, and incisors being progressively less affected.

An abscess rate of 1.4% (14/1032) was arrived at for the total series with 11 of the 14 cases occurring in the mandible, the most frequent site being in the alveolar borders of the molar region (50.0%).

Periodontal disease was evidenced by "calculus build-up", "alveolar recession", and "rolled rim". Incidences for the various manifestations are summarized in Table 20 for maxillary and mandibular series on a 0 to +++ scale. Fragmentation often made this observation somewhat impossible and only complete, well-preserved specimens were used.

Concretions were quite marked in the selective sampling which might be attributed to functional-environmental causes rather than to pathology. However, recession of the alveolar margins are correspondingly marked and the occurrence of rolled rim is strong enough to support a pathological manifestation rather than a dietary-influenced one. From these observations, periodontal disease may be said to have a high rate of occurrence among the individuals with roughly two-thirds of the jaws being affected to some degree.

### 3.8. SUMMARY

The sample under consideration may be characterized morphologically as most commonly having the "+5" fissure pattern on its molar teeth

(44.1%) with the "+4" pattern being the second most common; an incidence of 25.3% of its maxillary incisors depicting various degrees of shovelling; the molars decreasing in size distally; and sporadic cases of hypodontia, tooth rotation, and other anomalous traits.

The dental health can be summarized;—there is a low caries rate (8.3%) in all teeth, the most common type being the neck or interproximal variety occurring most often in the molars; an abscess rate of 1.4%; teeth wear not severe but rather of the cusp blunting type with dentine and pulp exposure infrequent; a low incidence of premortem loss (8.7%); and a fairly high occurrence of periodontal disease.

## 4. INFRACRANIAL

### 4.1. Vertebrae and Sternum

Morphological observations of the vertebrae were directed to variations of the superior articular surfaces, foramen transversarium, spinous processes of the cervical vertebrae, laminal spurring of thoracic and lumbar components and traits specific to C-1, C-2, and the sacral complex.

### cervical (Tables 21 and 22)

### C-1.

The first cervical or atlas vertebra most often displayed a single, oval concave superior articular facet with no apparent sex differences observed; double and constricted structures being of minor occurrence. The foramen transversarium always took the form of a single aperture with differences in size frequently being noted.

No cases of "transverse bridging" (a ridge of bone extending from the superior articular process to the transverse processes) was observed, but three cases (sides) were observed to have a "posterior arch foramen" produced by a bony extension connecting the superior articular surface and the posterior arch of the vertebra.

### C-2.

Two cases of an ossified apical odontoid ligament were recorded on the dens process of the second cervical or axis vertebra.

The superior articular processes and foramina transversaria were always single structures with equal expression of size being the commonest relationship of the foramina of C-2, C-3 and C-4.

The "spinous process" of this vertebra was most often (61.1%) of a divergent bifid variety with parallel bifid being the only other alternative.

### C-3.

The third cervical vertebra frequently had a divergent bifid spinous process (62.5%) with a single non-bifid structure being the only other observed variation.

C-4.

The spinous process of this vertebra also was usually divergently bifid (54.5%) with the remaining instances of parallel bifid and single non-bifid being confined to male and female respectively.

C-5

The foramen transversarium was most often a single aperture with a doubling or spurred condition occurring relatively infrequently and the right foramen usually being smaller than the left (44.4%). The superior articular facet of this vertebra and of the remaining cervicals are all single structures. Three categories of spinous process variation were expressed almost equally.

C-6.

A single foramen was largely observed (64.3%) in the transverse processes of this vertebra, but doubling was not infrequent (32.1%). The side relationship was always disproportionate in size. A single, non-bifid spinous process was encountered a great deal.

C-7.

The foramen transversarium was most regularly a single aperture with division and spurring having a low incidence. Of three studiable

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FIG. 6—To-At-2-13. Inferior view of seventh thoracic vertebra showing "laminal spurring".

vertebrae, all were observed to have the right foramen transversarium larger in relation to the left representatives. Except for two cases (11.1%), the spinous process was singular.

### THORACIC, LUMBAR (Tables 23 and 24)

Laminal spurring (Fig. 6) had a high incidence and it occurred on either right and/or left superior and inferior lamina of thoracic and lumbar elements and was scored accordingly (16 categories) for each vertebra. For presentation purposes, all cases have been grouped into presence or absence as shown in Table 23. Highest incidences occurred from the fourth thoracic to the first lumbar vertebra with 69.7% of all thoracic and 35.0% of lumbar vertebrae showing this trait.

Incidences of laminal spurring for both males and females were high in the mid-thoracic and upper lumbar regions, but a very markedly increased rate was recorded for the female series. This apparent sexual dimorphism will be found later as being the case for osteoarthritic involvement of the articular facets of this same region of the vertebral column.

Measurements of the posterior bodies of the lumbar vertebrae were taken and these results and associated indices will be discussed along with stature calculations at the end of this section.

### SACRUM (Table 24)

No cases of lumbarization of the first sacral vertebra or sacralization of the fifth lumbar element were observed.

Sacral hiatus of the sacral components, however, was extremely prevalent and will be discussed under pathology. Mention is made here of the incidence rates which are of note. Of the two types discerned, "superior" and "inferior sacral hiatus", the latter occurred in 80.0% of the fifteen sacrums studied and the former in 40.0% of eleven adult specimens studied, each to some degree of advancement (Figs. 7-8).

### SUBADULT (Table 25)

Of the not yet mature individuals, incidences of morphological variations found in the vertebral column were much like those of the adult series. A few of these traits are presented in Table 25 with accompanying incidence rates. *Hiatus canalis sacralis* was evidenced for all five representatives of this age grouping and is discussed more thoroughly in the chapter on palaeopathology.

### STERNUM

This highly fragmented bone displayed no case of the "sternal foramen" that is sometimes found at the junction of the third and fourth sternebrae.

## 4.2. UPPER LIMB (Tables 26 and 27)

### CLAVICLE

The range of clavicular lengths was observed to be fairly constant with little difference for males (14.1 cm) and females (13.9 cm) being observed.

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FIG. 7—To-At-1-6. Sacrum with a "superior sacral hiatus" and a small inferior defect.

FIG. 8—To-At-2-26. "Inferior sacral hiatus" and a small superior defect.

Osteoarthritis of the articular surfaces of this bone, as well as others, will be discussed under degenerative changes in the section on palaeopathology.

### SCAPULA

The presence of a "suprascapular notch" was more often observed (81.3%) than a "foramen" (6.2%) or an "absent" (12.5%) category for this area.

A classification of "rectangle", "triangle", and "sickle-shape" was observed for the shape of the acromion with a rectangular outline being the most prevalent type (76.5%).

The "inferior angle" of the scapula was found to present a V-shaped conformation one-third of the time with a blunted "U-shaped" outline occurring for the remainder. Too few cases make these findings speculative.

### HUMERUS

A greater maximum length (32.3 cm) of the humerus was observed for males than for females (28.1 cm). Likewise, maximum and minimum head diameters were of a similar general relatedness as expected.

No cases of "supratrochlear spurring" were found, but a perforation or "septal aperture" piercing the olecranon and coronoid fossae was observed with an incidence of 15.4%. Unfortunately, five of the six observed examples were found in fragmented and miscellaneous material, making side and sex differences indeterminable and their status as an anomalous, not inflicted, trait uncertain.

### RADIUS

Maximum length and maximum head diameter of this bone again revealed the expected sexual dimorphism and side difference; the right side exceeding the left in length.

### ULNA

Values of 26.7 cm and 25.3 cm were recorded as being mean maximum lengths for males and females respectively for the ulna. The ulna was a more common site for a healed fracture than any other bone of the skeleton.

One case of a "distal spur" representative of an ossified ligament (articular disc ligament) of this area was found, being associated with a healed fracture.

## 4.3. Lower Limb (Tables 26 and 27)

### INNOMINATE BONE

Thirty-four point eight per cent of the twenty-three potentially observable acetabular margins displayed an "acetabular notch".

### FEMUR

Femora were lengthy, robust bones with little if any sexual dimorphism discernable; males (45.7 cm) and females (45.3 cm).

Mean values for platymeric indices of male (83.6) and female (81.8) specimens indicate a platymeric classification or considerable flattening of the subtrochanteric region. However, a range for individual indices was from hyperplatymeric to eurymeric (65.7 - 98.8). Difficulty was often experienced in taking the antero-posterior and lateral diameter measurements, mostly because of the degree of torsion and protrusion of bone in this region.

The pilastric index revealed a mean value of 114.8 for males and 110.7 for the female series.

A porous depression on the anterior surface of the neck of the femur, *Fossa of Allen*, was of low incidence (8.3%) and is thought to be concurrent with developmental processes (Anderson 1964, p. 51). This is also referred to by others as an *Empreinte* and has a high incidence among Maori femora (Schofield 1959, p. 98).

A proper "third trochanter" (tubercle structure similar to the "second trochanter") was never observed, but a "ridge" designation of varying degrees of expression was very common (96.8%).

### TIBIA

The mean maximum lengths of female tibiae reveal a slightly longer (38.6 cm) bone than that value obtained for males (37.9 cm).

The platycnemic index for both sexes ranges from platycnemic to eurycnemic values, while the mean for males (66.6) is representative of a mesocnemic tibial mid-shaft and a eurycnemic (71.1) value was obtained for the female group; females, therefore, may be said to possess a less flattened tibial mid-shaft region.

"Squatting facets" on the anterior distal extremity of the tibia were classified as "medial", "lateral", and "neck" facets. Seventy-five per cent of the tibiae capable of being observed for this trait showed some form, the various types being equally represented.

### PATELLA

The patellae were observed to be most often strikingly pointed inferiorly and spurs not infrequent. Mean patella module values of 3.7 and 3.5 were obtained for male and female respectively.

Three cases of a *Vastus notch* (12.0%) in the superolateral angle at the site of attachment of the *Vastus lateralis tendon* were noted. No other anomalies characteristic of this bone were found to be present.

### FIBULA

Very few fibulae were in a measurable state but a mean value for three male individuals was calculated to be 38.0 cm and one female (To-At-2-4) had a right fibula maximum length of 34.7 cm and a value of 39.9 cm for the left fibula.

### CALCANEUS

Variation of the anterior and middle talar facets was categorized as "single", "double", or "constricted" entities with the "constricted" type or hour-glass formation occurring most often (72.2%) with no apparent sex or side difference. No other major categories of this variation were discerned.

### NAVICULAR

The posterior surface of this bone was found to have two major variations occurring of five possible (Anderson 1964, p. 53). "Inferior extensions" occurred most often (65.2%) with "pitted tuberosity" being the other major classification.

### TALUS

The so-called talar squatting facets were broadly defined as true "squatting facets" and "talar extensions" after Barnett (1954, pp. 509-510) with a modification of this basic scheme by inclusion of a "neck facet" category similar to Morimoto's "$E_1$" type on the superior surface of the neck of the talus originally described by Suzuki in 1950 (Morimoto 1960, pp. 161-162).

True "talar squatting facets" were most often of a "medial" kind (34.3%) with no apparent sex difference. A "medial extension" was more frequently (44.4%) observed for both sexes than any other classification.

### SUBADULT (Table 28)

Very few traits of the very few immature long bones were able to be observed and recorded. A summarization of these selected traits is presented in table form (Table 28) along with a "Grand total" incidence computed for the majority of these morphological observations disregarding age, sex and side distinctions.

Measurements (maximum lengths) of subadult long bones by individual are to be found in Appendix 2.

### 4.4. STATURE (Table 29)

By using various regression equations, an estimate of the living stature is obtained (see Trotter and Gleser 1958). Formulae incorporating different long bone maximum lengths were utilized so that estimates for a maximum number of individuals were obtained. The left length measurement was used when available and the same equations were used for male and female specimens. The most preferable equation available for an individual was used to represent that individual's estimated stature (Trotter and Gleser 1958, p. 120). No attempt to average the individual estimates, each usually utilizing different equations, for the total series was undertaken. Both Mongoloid and White equations were used, with White formulae probably being the better estimate.

These estimates are indicative of an anthropometrically tall people with a few individuals being found to approach and, in some cases, exceed six feet in height. (To-At-2-4 is outstanding as having been calculated as the tallest individual of the present sample.)

### 4.5. LIMB PROPORTIONS (Table 30)

Only minimal limb proportion indices were able to be calculated and again visual inspection of the results is the only means of estimating a general tendency.

The brachial indices reveal a proportionately shorter forearm in contrast to the upper arm length for these individuals.

Tibio-femoral indices were all less than 83.0 with one exception, indicating a proportionately larger femur for all cases here presented. This is basically in accordance with White and Mongoloid values.

The intermembral index was low, indicating longer legs than arms exclusive of the distal extremities.

### 4.6. POSTURE

By measuring the posterior and anterior heights of the lumbar vertebral bodies, it was hoped to arrive at an estimate or conjecture concerning the posture of an individual from the concomitant indices.

The lumbar vertebral index will be indicative of posterior concavity or posterior convexity and associated with pathological changes. Only four vertebral indices were able to be calculated as all five intact lumbar vertebrae were necessary for this computation. However, the means all exceed 100 which indicates lesser posterior convexity of the lumbar region and is also the finding of the individual lumbar indices calculated for each lumbar vertebra (see Table 26).

### 4.7. BUILD

A very relative and subjective appraisal of build is gained through general robustness and muscle-markings found stamping the bones. In this case, the skeletal remains here studied were representative of a truly robust and highly muscular people. Clavicular robustness, heavy limb structuring, evidence of strong muscle attachment (and other sturdy indicators) are the evidence which support this view.

## 5. PALAEOPATHOLOGY

### 5.1. INTRODUCTION

Pathology will be dealt with systematically in several categories. For classificatory purposes, those diseases manifested on the bony remains will be grouped as degenerative changes or osteoarthritis, trauma, infectious diseases, congenital disorders, and any other evidences of pathology. Dental pathology has already been treated in the chapter on dentition.

### 5.2. DEGENERATIVE CHANGES

All degenerative changes or osteoarthritis of the articular surfaces on long bones, articular facets of vertebrae, and the marginal areas of vertebral centra were scored on a 0, +, ++, +++ basis. The frequency of occurrence of all types of arthritic involvement is presented in table form according to the assigned sex or mound association with side (R. or L.) being specified.

#### ARTICULAR SURFACES OF LONG BONES (Tables 31 to 37)

Lipping, spicules, spurring, pitting and other bone proliferations observed at the articular ends of long bone were lumped under the term "osteoarthritis". Such manifestations were relatively subdued in the present sampling, "+" being the usual score given if arthritic involvement was at all present.

Table 31 summarizes arthritic changes in the shoulder, elbow, and hip region. Medial and lateral extremities of the clavicle display similar amounts of complication.

Right and left glenoid fossae of the scapulae likewise show equal amounts of involvement with no apparent sex difference. Humeral heads are comparatively less affected, incidence being almost halved.

Capitulum, trochlea and the proximal articular surface of the ulna reveal a progressive increase in the amount of lipping with the frequency for females always higher than the males. In several instances, a percentage of 100 is assigned to the adult women and a total incidence of 87.1 per cent for arthritic involvement of the proximal ulnae is relatively outstanding even though sample sizes are somewhat small.

The sacro-iliac is another region of greater involvement whereas acetabulum and femur heads are less implicated. It may be worthy of mention that of the eight male femur heads studiable, no degenerative manifestations were present, whereas two of the five females' articular surfaces did display degeneration.

Too few distal femur surfaces were studiable with a slight improvement among the proximal tibiae. These two areas along with patellae denote the knee region in Table 32. The usual arthritic complication of the patella was superior spurring which occurred in half of the specimens. The proximal end of the fibula was also noticeably involved.

Articular lipping was quite pronounced in the wrist region as may be surmised from Table 33. Arthritic changes of the metacarpals of the right and left hand were compared on a mound basis and a remarkably high degree of correspondence was found. As expected, greater frequencies of occurrence were found for the proximal portions with MC-5 having the highest percentage and MC-3 the lowest (Table 34).

The ankle (Table 35) is a frequent site for degeneration with distal tibial and fibular surfaces possessing equal incidence rates. Talus, calcaneus, and navicular bones are subject to greater involvement than the other bones of the ankle.

The metatarsal (Table 36) articular surfaces appear less engrossed in degenerative changes than the metacarpals, again with the distal extremes showing little or no involvement. Proximal MT-1 reveals the highest incidence (51.5%) with remaining tarsals showing less but fairly equal amounts.

Observations of degenerative changes were made for individual phalanges where discernible, but have been lumped into proximal, medial and distal hand and foot phalanges with the exception of the phalanges distal to MC-1 and MT-1, which are presented separately (Table 37).

The proximal end of the distal phalanx of the first finger displayed osteoarthritis more often than the other sites on these phalanges. Likewise, the proximal distal phalanx of the first toe was also most often involved as expected. The remaining hand and foot phalanges show little or no involvement.

An attempt to weight the various degrees of involvement and to use a mean value was made by assigning values of 0, 1, 2 and 3 to 0, +, ++, and +++ scores respectively so that a value of 0 will indicate no degeneration and a value of 300 depicts the greatest amount of involvement possible. It was found that the proximal ulna is the site of greatest lipping and that distal radius and bones of the ankle are also generally arthritic. It was also found that in general the occurrence of osteoarthritis was not severe.

PRESACRAL VERTEBRAE (Tables 38-41 and Diagrams 1-4)

The superior and inferior margins of the vertebral bodies often display the bony proliferation referred to as osteophytosis (Bourke 1967, p. 362). This type of degeneration occurred more often in males than in females

(Table 38). Diagrams 1 and 2 permit one to discern visually the regions of the presacral vertebral column, as well as differences between superior and inferior borders, in which osteophytosis was more marked (modification after Stewart 1947, pp. 230-231; 1966, pp. 52-55). It can be seen that a greater amount of involvement is to be found in the lower lumbar and the lower cervical region with considerable reduction in the upper and lower thoracic region.

In general, the lumbar vertebral margins are more arthritic, followed by the cervical and then very closely, if not equally, by the thoracic vertebrae when summation of all frequencies for each region are compared.

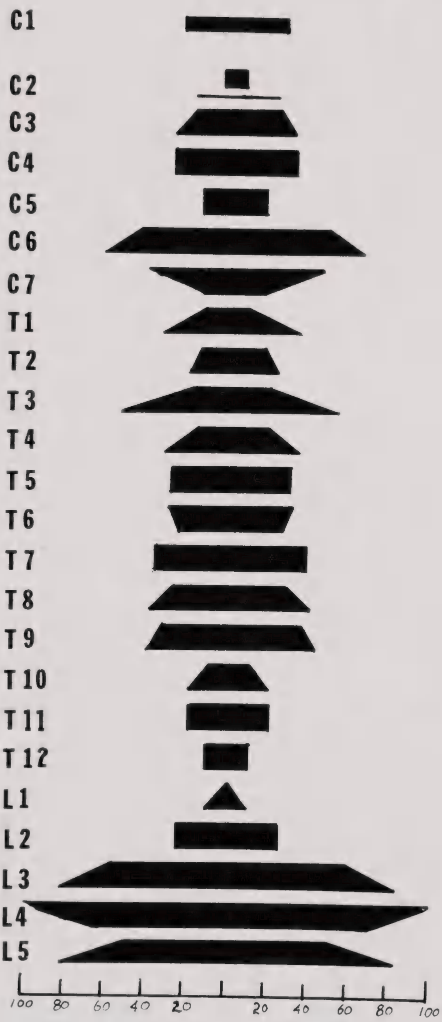

DIAGRAM 1—Osteophytosis of superior and inferior vertebral margins of the presacral vertebrae of Tongan males (5 to 15 representatives). Mean values were obtained by scoring on a 0 to 3 basis x 100.

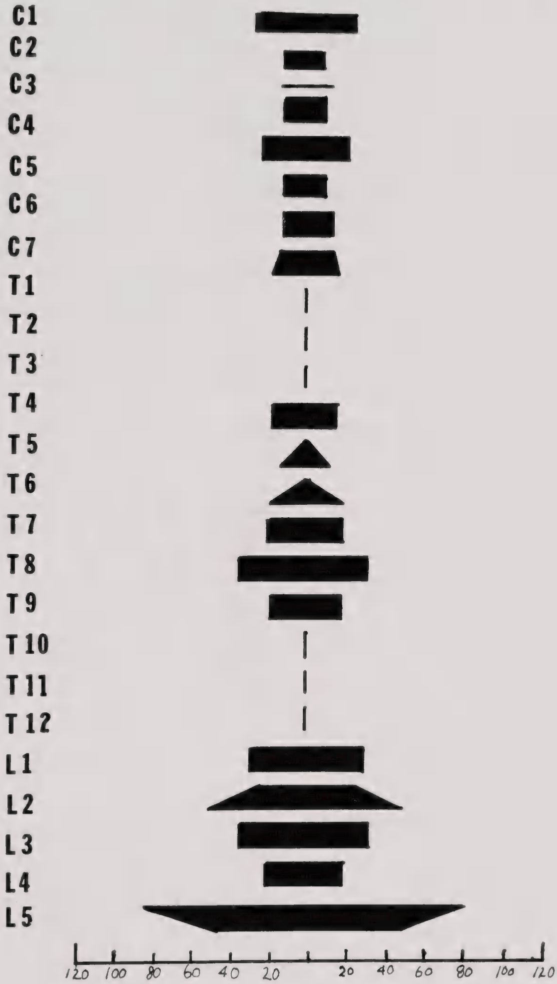

DIAGRAM 2—Osteophytosis of the superior and inferior vertebral margins of the presacral vertebrae of Tongan females (3 to 9 specimens).

Right and left superior and inferior articular facets of the presacral vertebrae were examined for osteoarthritis and percentages of any kind of involvement (+ to +++) have been tabulated (Tables 39, 40 and 41). The articular facets of C-1 and C-2 show greater complication than the remaining cervical vertebrae, again more so for the male series. The facets of the male thoracic region were relatively uninvolved whereas those of the female sample are in most cases markedly so, representing almost the converse of the cervical region in regard to sex-correlation. The lumbar region reveals a continuation of progressive involvement in the female line; osteoarthritis obtaining its greatest frequencies here. The lumbar region of the male shows no involvement until arriving at L-4 and L-5 and even then the frequencies do not rival the female incidences. For visual inspection, Diagrams 3 and 4 have been drawn.

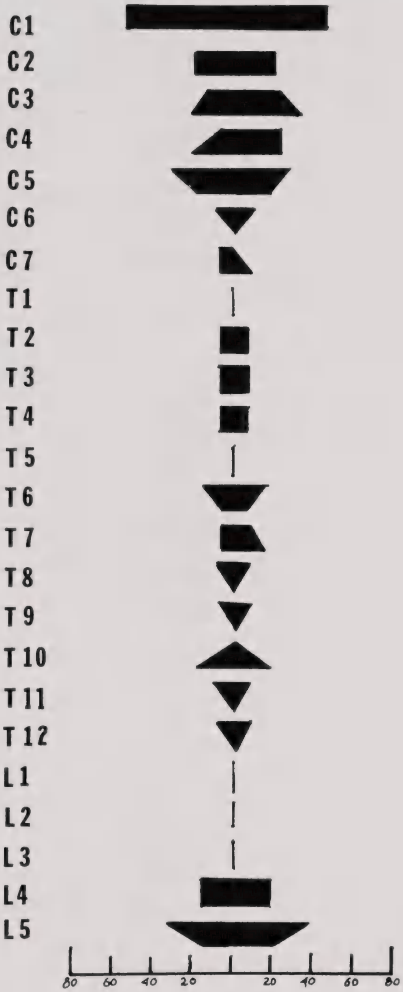

Diagram 3—Osteoarthritic lipping of right and left superior and inferior articular surfaces of the presacral vertebral column of Tongan males (5 to 15).

SKULL (Tables 8, 9 and 6)

Osteoarthritis of the temporo-mandibular joint was found to have an incidence of 30.8% for male and 9.1% for female skulls (Table 8). A per skull incidence of 18.8% for males and 28.6% for females was found for arthritic involvement on the condylar surface of the mandible (Table 9).

An incidence of 58.8% was found to express some degree of arthritis occurring on the paired occipital condyles of the adult skulls examined (Table 6).

### 5.3. TRAUMA

It has been said that early closure of the cranial sutures could possibly be held responsible for the cranial deformation often noted for Tongan

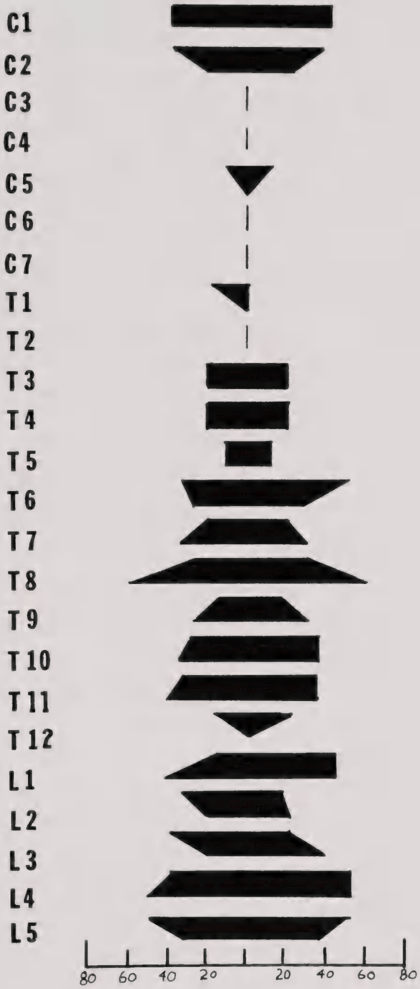

DIAGRAM 4—Osteoarthritic lipping of right and left superior and inferior articular surfaces of the presacral vertebral column as found in Tongan females (4 to 9). Comparatively greater arthritic involvement is observed to occur from mid-thoracic through the lumbar region as contrasted to the male sample.

crania including this collection (Marshall and Snow 1956, p. 420; Shima 1966, p. 140). However, no skulls were classified as such by the present researcher. Sixty-nine point six per cent of the coronal sutures in adults (23) were observed either to have fused (17.4%) or to be in the process of fusing. Fifty-four point two per cent of the sagittal and 26.1% of the lambdoid sutures (23) were in a similar condition.

Healed fractures were most commonly found in the forearm. Additional sites of fracturing were in the hand (phalangeal) and foot (metatarsal) skeletons. The other type of trauma found was a depression on the skull, probably due to a blow from a solid object, which was certainly not fatal.

Fractures were studied solely by gross inspection with callus formation, disalignment of the normal axis, and other deformities that follow breaking being the usual manifestations. It is quite conceivable then that some instances of early and well-healed fractures were missed, especially in the hand and foot regions. Furthermore, the clavicle, a commonly fractured bone, was not well represented or preserved. Only 'sure' cases will be presented here, according to their catalogue designation.

*To-At-1-12.* There is a finger-tip depression on the left parietal bone in contact with the left parietal foramen and circular in outline. It is probably a healed puncture wound.

*To-At-1-34.* (Fig. 9) The left ulna of this young male shows a distal fracture so well healed as to appear set purposely.

*To-At-2-1-C.* (Fig. 10) There are healed fractures of the right radius and ulna diagonal to one another. The radius is greatly disaligned, creating a large foramen and both fractures probably occurred in advanced adulthood.

*To-At-2-4.* (Fig. 11) The right ulna reveals a well-healed heavily calloused fracture occurring in its distal third.

*To-At-2-18.* Two proximal phalanges of the right hand show possible healed fractures. MT-5 in lateral view is quite noticeably bowed inferiorly. Furthermore, the left ulna revealed a healed fracture of its middle third accompanied by a great deal of callus formation (Fig. 12).

### SUMMARY OF FRACTURES

Four ulnae and one radius were found to have healed fractures. The fractures of the male forearm were confined to the left limb, while those of the female were of the right limb. Other healed fractures and a healed puncture of the skull were also noted.

## 5.4. INFECTION

The individual cases to be presented here are thought to be due to diseases brought about by the invasion of infectious organisms. The manifestations will be grouped under treponematosis, which will include combinational treponemalseptic osteomyelitis pictures, less specific periostitis as found in the skull and typically severe cases of destructive changes found in the vertebral column. Classifying of the individual maladies as such implies a tentative diagnosis for these affected individuals.

### TREPONEMATOSIS

*To-At-1-4-B.* (Figs. 13-31)

Almost all of the fragments that are representative of this individual are involved in similar bone lesions that are typical for the majority of the cases to be described in this section.

Three rib fragments were found to display a swollen and ulcerous cavitated cortex with occasional perforation and jaggedness of their inferior borders. The ulcerous depressions were only a few millimetres in diameter, separate and their margins vaguely outlined. X-rays revealed nodular

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FIG. 9—To-At-1-34. Left ulna displaying a healed fracture in its distal quarter.

FIG. 10—To-At-2-1-C. Poorly healed fractures of the distal right radius and ulna juxtaposed diagonally.

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FIG. 11—To-At-2-4. Right ulna revealing a healed fracture and resulting distortion.

FIG. 12—To-At-2-18. Left ulna showing a well-healed fracture (two ?) with heavy callus formation in mid and distal regions.

patches of lesser density in contrast to a heavier general interior. A cross section taken midway discerns a moderately dense matrix composed of a swollen lattice network (Figs. 13-15).

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FIG. 13—To-At-1-4-B. Rib fragment.

FIG. 14—X-ray of fragment.

FIG. 15—Transverse section taken at centre of fragment.

FIG. 16—To-At-1-4-B. Tibial mid-shaft fragment, showing a hypertrophied and tree-trunk-like appearance.

FIG. 17—X-ray of fragment.

FIG. 18—Cross-section at mid-point of fragment, showing a thickened periosteum and nodular lattice-work surrounding a 'decayed' cavity.

A mid-shaft fragment (tibia ?), noticeably swollen, showed roughened concavities externally with a greatly filled in medullary core at one end. On X-raying a dense matrix was apparent, especially at its immediate circumference, a much lesser density being found at its opposite extreme. Cross sectioning in its thicker region revealed osteoperiostitis involvement resulting in a thick sheath composed of a nodular lattice-system surrounding a 'decayed' cavity once probably veiled in an extremely fine and porous architecture of lamellae. At the opposite end of this fragment only a thin plate-like (sequestra) cortical layer remains with nothing adhering internally (Figs. 16-18).

A left humerus (distal half) fragment appeared externally swollen and characteristically pitted. The medullary cavity was greatly filled in distally by concentric circles of small similar manifestation as already noted with more extreme thickening occurring distally where there is a near or complete blockage of the medullary cavity (Figs. 19-21).

A (right ?) radius shaft fragment is enveloped in typical lesions along its entire length. A transverse section depicts a completely obliterated cavity in areas of greater cortical involvement, with a more normal internal appearance elsewhere, although here the cortex may be thinned more than is usual (Figs. 22-25).

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FIG. 19—To-At-1-4-B. Left humerus (distal half) in two pieces.
FIG. 20—X-ray of medial fragment.
FIG. 21—Cross section taken at the distal end of the medial fragment.
FIG. 22—To-At-1-4-B. (Right ?) radial fragment.
FIG. 23—X-ray of fragment.
FIG. 24—Cross section of fragment.
FIG. 25—Another cross section taken more distally.

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FIG. 26—To-At-1-4-B. Midshaft fragment (humerus?).
FIG. 27—X-ray of fragment.
FIG. 28—Transverse section taken at centre of fragment.
FIG. 29—To-At-1-4-B. Long bone (fibula ?) fragment.
FIG. 30—X-ray of fragment.
FIG. 31—Cross section of fragment.

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FIG. 32—To-At-1-21-A. Superior view of skull with multiple porous foci, some co-joining and creating large areas of destruction.

A mid-shaft fragment displays a general increment with large pitted cavities on its medial side. A cross section of this area reveals an occluded medullary cavity (Figs. 26-28).

Another shaft fragment appeared distorted and slightly inflated but greatly filled anteriorly, leaving a passageway of only about 1 mm in diameter (Figs. 29-31).

*To-At-1-21-A.* (Fig. 32) The reconstructed calvaria of this adult of unknown sex displays extensive destruction of the outer plate and part of the diploe in a side frontal-parietal (sagittal) area composed of ulcerous potholes of varying depths and expanse, with striations sometimes occurring concentrically. These multiple foci of cratering sometimes meet nearby centres of destruction gouging out what must be new bone formation. The bone consistency appeared spongy and irregular.

A left ulna fragment, comprising the greater part of this bone, was characteristically swollen with ulcerous, single cavities pocking its surface. A left radius fragment and clavicle were apparently unaffected as well as the upper limb bones of the right side, excepting an intrusive (?) distal fragment of a right ulna also swollen and typical of the kind of pathology being described.

*To-At-1-21-B.* (Fig. 33) Both right and left tibial shaft fragments of this adult are characteristically pathological. One shows a typical concave and ulcerous depression while the other displays a more convex structure in an area of greatly thickened cortex.

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Fig. 33—To-At-1-21-B. Right and left tibial shaft fragments displaying typical treponemal lesions on their surfaces; porous oval concavities and swelling in areas of active affliction.

*To-At-1-29-A.* An adult male. The whole left tibia reveals an expanded shaft in the proximal region and more intense involvement anteriorly with little surface indication other than the already mentioned increment. Several holes observed in the condylar region are probably due to root growth rather than to pathology. No other bones representing this individual display a typical involvement.

*To-At-2-5.* (Figs. 34-36) A left fibula fragment (distal half) displays sharp, jagged linear margins. A denseness is shown in an X-ray of this fragment. A cross section exposes a well preserved, although very rigid cortical structuring which is probably atypically calcified. Other bones representative of this individual are confined to the foot which appears uninfected.

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FIG. 34—To-At-2-5. Distal fragment of left fibula displaying jaggedness and stone quality.

FIG. 35—X-ray of fragment.

FIG. 36—Cross section taken in the distal part of the fragment superior to the fibular head.

FIG. 37—To-At-2-10. Fibular fragment.

FIG. 38—X-ray of fragment.

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FIG. 39—To-At-2-37. Medial fragment of right tibial shaft.

FIG. 40—X-ray of fragment.

FIG. 41—Cross section taken at mid-point of fragment.

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FIG. 42—To-At-2-37. Distal fragment of right tibia, in two pieces, showing lesions typical of treponematoses and severe septic osteomyelitis.
FIG. 43—X-ray of distal components.
FIG. 44—Cross section taken medially.
FIG. 45—Cross section more distal to that shown in Fig. 44.
FIG. 46—Cross section taken still more distally.
FIG. 47—Cross section taken most distally, superior to area pierced by cloacae.

*To-At-2-10.* (Figs. 37-38) A left fibula shaft fragment missing its proximal and distal extremities appears densely thickened while its external surface keeps much of its design although rigid. Cross sectioning proved to be very difficult. The more accreted zone revealed a greatly reduced medullary cavity and a cortex of an extremely hardened and stonelike consistency. No similar expression was observed in the right tibia, fibula, and foot bones and fragments.

*To-At-2-23.* The right tibia (distal half fragment) of this individual displays typical swelling and ulcerous protrusions on its surface confined mostly to the distal third. The other skeletal representation of the lower limb including the left tibia does not show similar lesions.

*To-At-2-37.* (Figs. 39-47) A right tibia is in three major fragments, all highly pathological, revealing extreme septic osteomyelitis accompanied by large involucra, dead sequestral plates, distortion, and fusion distally with the right fibula into a monstrous bony mass. The tibia as a whole tapers to an extremely small diameter. More proximally it develops into a highly uncontrolled growth. Also associated with this bone assemblage is a left fibula fragment swollen and characteristically pathological.

The major fragments of the right tibia are:

(1) A distal third fragment, highly distorted with large involucra and foramina transversing its surface, swollen and markedly curved

inward (medially). Fusion of the right fibula is apparent distally but its extent superiorly is camouflaged and uncertain. Cross sectioning reveals a completely filled in cavity of compact silica-like consistency with the possible exception of a pin hole at its centre. X-ray confirms this solidity.

(2) A middle third fragment (a continuation of the distal fragment) narrows to a diameter of 19 mm or less. A transverse section shows a very reduced cavity filled in by a small core of porous bone and then surrounded by a more dense type. Another section, taken more proximally, still reveals an inflated centre although a passable cavity becomes evident at the mid-shaft point.

(3) A proximal third shaft fragment is greatly hypertrophied. Cross sectioning exposed a thickened cortex of dense matrix with a more fibrous inner consistency in addition to more dense, secondary increments concentrating around involucra and/or vessel passages within this cancellous network (sclerotic type margins). A more proximal section revealed a more porous and highly rarefied condition lightening the bone as a result.

The left tibia of this individual was unaffected.

*MS1.* This is a partially reconstructed skull of a female whose frontal bone is covered with flattened smooth lumps, a single ulcerous and rarefied centre being confined to the left supraorbital region.

*To-At-1-10.* This reconstructed calvaria revealed ulcerous centres of various sizes occurring mostly along the sagittal plane. At times these lesions take a fine porous nature sprinkling large areas of the parietal and

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Fig. 48—To-At-2-21. Metatarsal bones of the left foot, with Mt-2 and Mt-3 revealing swollen areas distally and distortion (healed fractures ?).

frontal bones. No other pathology was noted except for the marked recession of the alveolar margins and moderate calculus build-up of the dental margins.

*To-At-2-21.* (Fig. 48) Metatarsal bones of the left foot of this individual were diagnosed earlier as healed fractures (no X-ray to confirm this) but because of their swollen nature and what appears to be a drainage cloaca on MT-3 and rarefication of the cortex accompanied by an oval excrescence on MT-2 their placement with other cases of infectious or treponemal diseases is quite plausible.

Other limb bone representation of this individual fails to show similar involvement.

### VERTEBRAE

These single cases have been included here to differentiate them from a more generalized type pathology as they may be due to more specific vectors of an infectious origin and more prolific disease of the spine.

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FIG. 49—To-At-2-13. Cervical vertebrae C-1 through C-7 in articulation.

*To-At-2-13.* (Figs. 49-50) The cervical vertebrae (C-3 through C-6) display much osteophytic involvement of their centra and lipping of their articular surfaces. Articular facets are largely obliterated by spongy masses, especially C-3 through C-5, whereas the bodies are wedge-shaped and eroded by cloacae internally.

*To-At-1-12.* (Figs. 51-52) The cervical vertebrae (C-2 through C-7) were observed to display extreme osteophytosis of their bodies; excessive lipping of their margins, erosions and drainage cloaca being evident. The

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FIG. 50—To-At-2-13. Inferior views of C-3, C-4, and C-5.

rest of the vertebral column was observed to be free of any type of osteophytic, degenerative, or pathological involvement as was true for the remaining skeletal parts.

*To-At-2-18.* The third, fourth, and fifth lumbar vertebrae of this specimen showed excessive lipping of the marginal area of their bodies associated with moderate internal erosive and drainage pathways.

## SUMMARY

The pathology described under this heading is suggestive of treponematosis or osteomyelitis-producing agents either alone or in combination and is therefore worthy of summary. The typical lesions were found on ribs, humeri, radii, ulnae, tibiae, fibulae, metatarsal bones (?), vertebrae (?), and crania. Even though bone representation was not equal, the tibiae seem to be the bones affected (35.7% of the individual cases) most often and most severely. The fibula and ulna were also frequent sites. No cases of affliction of the clavicles, femora, innominate bones, or hand bones were noted. All thirteen individuals were adults. Only seven have been assigned a sex previously and of these, five were males (19.2% of known male population) and two were females (9.5% of the known female sample).

It is also apparent that we may be observing different stages of this disease and assurance is gained on reviewing radiological and clinical descriptions of more recent patients suffering from yaws (Davies 1961; Goldman 1943; Montel and Couput 1932).

To place a specific label on these cases would be highly presumptuous without other information since there is disagreement concerning even modern day cases of treponematoses in their diagnoses (syphilis and yaws

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FIG. 51—To-At-1-12. Posterior view of articulated cervical vertebrae C-2 through C-7.

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FIG. 52—Superior views of same vertebrae revealing eroded bodies.

having similar clinical and radiological pictures) and also of the evolutionary course and/or environmental relationships. To say that these are definitely cases of yaws is therefore teleological and open to debate. In spite of the fact that my specimens are supposedly prehistoric and were once inhabitants of a tropical Pacific island, prerequisites which some say free a treponemal case from a 'syphilis' label (see Stewart and Spoehr 1952), a 'yaws' label cannot be definitely assigned because of the unsettled controversies over historical documentation, evolutionary (spatial and temporal) courses, and reliable diagnostic features of at least two modern day manifestations of this category of diseases. "Syphilis and yaws possess striking similarities" is the conclusion researchers of syphilis and yaws often arrive at after they give a few scant dissimilarities with reservations even for these (Hamlin 1939, pp. 29-30; Goldman and Smith 1943, p. 237; Stewart and Spoehr 1967, p. 318; Davies 1961, p. 25).

### PERIOSTITIS-OSTEOPOROSIS-NEOPLASMS

*To-At-2-13.* A slight porosity of the brow region was noted for this individual in addition to a small nodule of bone (neoplastic) superior to the right supraorbital area comprising three small convexities to give only a slight mounding structure. A much larger buttonlike osteoma and a smaller one, anterior to it, were also observed on the left parietal bone near the sagittal midline. The cervical vertebrae have already been dealt with.

### PERIOSTITIS-OSTEOPOROSIS

*To-At-2-32.* The fragmented remains here represented display periostitis-like characteristics. Soil erosion and acidity may or may not be attributed as the cause.

*To-At-1-26.* The parietal and occipital surfaces of this skull show a fine porosity reminiscent of small 'pin' pits. These may also be assigned to soil agents as these remains were observed to be slightly stained. No other pathology was observed in the infracranial bones.

*To-At-2-31.* (Fig. 4) Porosity of the vault surfaces of this individual's skull was also quite noticeable (cause ?).

### 5.5. Other Anomalies and Pathology

*Hiatus canalis sacralis* or the failure of fusion of posterior sacral halves appears to be a frequent trait among the present sample with both cephalad ("superior") and caudal ("inferior") bases to be considered in its description. Percentages for the different variations can be found in Table 24 which reveals a cephalad base approaching the S-1/S-2 junction to be the most common type (25.0%) and also a S-4/S-3 base for a hiatus arising caudally to be the most frequently encountered (26.7%).

Of five subadult sacra or fragments of this region, each individual represented displayed some expression of the defect. Three individuals revealed defects of the inferior sacral components but their origins and extent could not be determined. Of the two remaining cases, well developed hiatuses arising inferiorly and superiorly were observed.

Incidence rates for male and female are about equal with seven male and three females having one or both expressions. Two individuals (males) were observed to have the dual combination of hiatuses.

Inclusion of this variable trait under pathology is tentative as individuals with sacral hiatus variation may or may not have suffered from maladies associated with a clinician's description of *spina bifida* of the presacral vertebrae. However, extremely pathological cases affecting the entire skeleton have been attributed to the condition which I have been calling "superior sacral hiatus" (Rowling 1967, p. 278). This does not seem to be the case with these particular specimens as no gross pathological involvement was found to occur in association with this trait with the possible exception of To-At-1-6.

*To-At-1-6.* (Fig. 7) Both types of hiatuses were found in the sacrum of this middle-aged male. A "superior sacral hiatus" extends inferiorly to the junction of the second and third elements, while another defect reaches the S-4/S-5 region inferiorly. No other gross anomalies of the vertebral column of this individual or of the rest of the infracranial skeleton were in evidence. Cranial pathology is suspected, however, for this individual.

*To-At-1-7.* This aged male, although possessing a somewhat fragmented sacrum, revealed an "inferior sacral hiatus" extending up to the mid-S-4 element. Of the remaining skeletal remains of this individual, no other pathology except a peculiarity of the frontal region of the skull was noted.

*To-At-1-29.* Again, although the sacrum was damaged, an "inferior sacral hiatus" was found to reach the S-3/S-4 junction of this adult male with no other pathology being noted.

*To-At-1-31.* This adult male also displays an "inferior sacral hiatus" approaching the S-4/S-5 junction. Of the little other skeletal representation here, no additional pathology or anomaly was observed.

*To-At-1-34.* The "superior sacral hiatus" of this young adult male was similar to that of To-At-1-31.

*To-At-2-4.* A sacral hiatus was observed to reach the S-3/S-4 junction. Congenital absence of the first thoracic vertebra, pathological involvement of the sternal (cartilage) articular surfaces of the first ribs, an irregularity of the sternum, and a healed fracture of the right ulna, were also found in the skeleton of this supposedly adult female.

*To-At-2-26.* (Fig. 8) A hiatus extending downward to the S-1/S-2 junction and one extending upward to the S-2/S-3 union were observed in the sacrum of this adult female. No other gross pathology of the infracranial bones available for study was noted.

*To-At-2-27.* A female of unknown age with an "inferior sacral hiatus" approaching the mid-S-4 region is also of significance.

*To-At-2-42.* An adult male with a hiatus reaching inferiorly to the mid-S-2 component and a small defect reaching superiorly to the S-4/S-5 junction is here noted.

*To-At-2-41.* A fragment of the sacrum of this aged male revealed a hiatus but its extent was not able to be determined.

*Miscellaneous.* Three uncatalogued specimens possessed hiatuses which are included in the total incidences presented in Table 24.

### HIATUS SACRALIS (subadult cases)

All of the subadult individuals possessing "sacral hiatus" were of a late adolescent age grouping.

*To-At-1-14.* A "sacral hiatus" was evident in the fourth and fifth sacral elements but its extent was uncertain owing to fragmentation of this individual's sacrum.

*To-At-1-22.* A "sacral hiatus" was observed in the small fragment representing this subadult.

*To-At-2-1-E.* An unfused posterior arch was evident in the fragment (fifth sacral vertebra) of this subadult.

*To-At-2-11.* A "superior sacral hiatus" was observed to penetrate as far as the S-1/S-2 junction and an "inferior sacral hiatus" approached the S-4/S-5 junction.

*To-At-2-19.* An almost complete sacral hiatus was here in evidence as an "inferior" hiatus reaching the mid-S-3 point and a "superior" hiatus was invoked as far as the mid-S-2 region.

### UNDIAGNOSED

*To-At-1-6.* The skull of this middle-aged male appeared generally large and squarish. The brow ridges were not prominent but had a worn-down appearance. Bone resorption or a smoothing of the angularity of the nasal borders was also noticeable. Premortem loss of the maxillary central and left lateral incisors and the left canine were also observed and the palate was noticeably deep. Of the infracranial skeleton, no other changes or pathology were of note except for *spina bifida* of the sacrum already discussed. Specimens of sclerotic arteries were found in association with this individual's skeletal remains.

*To-At-2-4.* The sternal articular ends of the right and left ribs of this adult are greatly swollen and the internal structure is of a spongy germinal consistency.

*To-At-2-8.* The tibiae of this individual are unusually bowed.

### CONGENITAL ABSENCE OF VERTEBRAE

*To-At-2-4.* This individual also displayed a congenitally absent thoracic vertebra (first ?). Presence of five lumbar and all the cervical elements, articulation of the vertebrae present, and careful exhumation of this individual confirms at least that there is a deletion in the thoracic region unaccounted for except by an explanation of congenital absence.

The sternum of this individual revealed the articular surfaces to be set at an oblique angle on either side of the sternebrum and a spur (xiphoid) formation inferiorly. Healed fractures of the right radius and ulna have already been mentioned for this individual.

### PHALANGEAL FUSION

*To-At-1-12.* The distal and medial phalanges of the left index finger of this individual were fused into one unit. A depression on the left parietal bone and pathology of the cervical region have already been noted.

*To-At-2-5.* Fusion of the medial and distal phalanges of the right fifth finger is here noted. A left fibula fragment of this same individual has already been described under "infection".

*To-At-2-20.* The medial and distal phalanges of the fifth finger of the right hand were observed to have fused together.

## 6. COMPARISONS (Table 42)

Since data comparable to the nature of my analysis (non-metrical morphology for the most part) are extremely rare for Polynesia and virtually non-existent for Western Polynesia, a spatial relationship within the Pacific area is impossible at this time. Comparable metrical analyses, however, are available and have been the bulwark of comparative studies from subjective and highly inferential diagnoses up to sophisticated statistical manipulations making use of distance formulae on living and osteological remains (Sullivan 1922, 1923; Shapiro 1943; Wagner 1937; Marshall and Giles n.d.). In view of the descriptive theme of this report, it is thought that a more consequential comparison could be advanced by examining data gathered on living subjects from a relatively modern era in contrast to my sample representative of an earlier period.

Such comparative data is largely of a metrical nature concerning the cranial region as this is the most easily equatable of somatological findings. Sullivan's monograph on living Tongans circa 1920 will be used for contrasting purposes (Sullivan 1922). Of the cranial measurements thought possible for this purpose, only five absolute dimensions and two indices were sought out as appropriate.

The original values for the living specimens were corrected by making use of facial skin thickness studies of His (1895) and Kollmann and Büchy (1898) and those suggested by Lee-Pearson when calculating cranial capacity from length, breadth and height measurements of the skull. These studies were mostly concerned with artistic restoration of the head to simulate appearance during life and are confined mostly to small cadaver samples (Krogman 1962, pp. 258-274).

Of these original five measurements singled out, probably only head length and width are to be considered as reliable. An arbitrary deduction of 8 mm was applied to the minimal frontal diameter as no data on skin thickness of this area was available in these studies. The bigonial diameter should also be closely scrutinized as His assigns a value of 24.16 mm to account for the thick musculature of this area, but Sullivan's readings were taken so as to avoid as much of this musculature involvement as possible. For this reason perhaps 10 mm is more reasonable.

Sullivan's original mean values and corrected values are to be found in table form along with mine for assessment (Table 42).

A test of statistical significance (t-Test) was computed for these temporally separated population samples and the trends to be discussed are based on their assigned statistical import.

The trend most emphasised, owing to the reliability of correction factors, larger sample sizes, and lesser variability, is that of a slight decrease in head length as shown by the male cranial results and associated greater cephalic index value implying a more brachycephalic population in recent times. Eleven millimetres were subtracted from these two measurements as recommended by Lee-Pearson (Martin 1957, p. 376; Wood-Jones 1929, p. 51). However, no statistically significant purport can be made for these findings.

The minimum frontal and bizygomatic diameters both suggest a narrowing of the face and a concomitant increase in the bizygomatico-frontal or frontal-jugal index, but only bizygomatic comparisons were found to be statistically significant and reliable.

Although not very reliable, the bigonial diameter is likewise in accordance with the general trend of facial narrowing to be expected in both males and females, but again the statistical significance found is highly tentative.

The differences are small and, for the most part, unsupported statistically as having any significance, a result which appears to be in accordance with Marshall's findings for Polynesia, of a 'conservative' brachycephalization for crania representative of this area. Of the absolute value differences, probably the decrease observed for bizygomatic diameter is the most striking (11.3 mm).

Most researchers have remarked on the stability of the Tonga-Samoa complex in cranial and general morphology. My analysis does suggest a slight tendency towards a small decrease in head length and an increased head width in addition to a tapering of the face which are all very much in line with earlier findings but are not supported by the statistical test of significance used. The only outcome of statistical validity that might be cited is the apparent facial narrowing of the more recent representatives in comparison to the prehistoric sample under consideration.

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## APPENDIX 1

1. Description of cranial measurements.
2. Individual skull measurements for adult male and female series.

### CRANIOMETRY

The thirty-two measurements taken and the indices calculated from them will be dealt with in this section. Sliding calipers (S.C.) and Hinge or spreading calipers (H.C.) were the two measuring instruments most used in this study.

1. **Cranial Length.** The length of the skull was taken as the distance between the most prominent point of the glabella and the most distant point posteriorly in the sagittal plane on the occiput (H.C.). Wood-Jones's No. 1; Martin's No. 1.

2. **Cranial Breadth.** Breadth was determined as the maximum transverse diameter of the skull above the supramastoid and zygomatic crest (H.C.). Wood-Jones's No. 1; Martin's No. 8.

3. **Cranial Height.** The height of the skull was determined by measuring the distance between the basion (anterior border of the foramen magnum) and the bregma (point where coronal and sagittal sutures meet) with the skull lying on its left side facing the examiner (H.C.). Wood-Jones's No. 1; Martin's No. 17.

4. **Cranial Capacity.** Capacity was calculated by use of Lee's formula using length, breadth, and height measurements. Male capacity $= .000266 \times (\text{length}=1) \times (\text{breadth}=2) \times (\text{height}=3) + 524.6$. Female capacity $= .000156 \times (\text{length}=1) \times (\text{breadth}=2) \times (\text{height}=3) + 812.0$ (see Comas 1960, p. 411).

5. **Cranial Module** (Schmidt's modulus). This index was determined by adding length, breadth, and height and dividing by 3.

6. **Cranial Index.** Length-breadth index was determined by using the formula:

$$\frac{\text{breadth}=2}{\text{length}=1} \times 100.$$

7. **Height Index:** length-height index $= \dfrac{\text{height}=3}{\text{length}=1} \times 100.$

8. Breadth-Height Index: $\dfrac{\text{height}=3}{\text{breadth}=2}$ x 100.

9. Basion-Nasion Length: the distance as measured by H.C. between the nasion (point of intersection of internasal and nasofrontal sutures) and basion landmarks. Wood-Jones's No. 1.

10. Basion-Prosthion Length. This measurement was taken as the distance between the alveolar point (the lowest point on the alveolar margin of the upper jaw between the two central incisors) and basion (H.C.).

11. Gnathic Index: alveolar index. Wood-Jones's No. 7.

12. Minimum Frontal Breadth: the shortest horizontal diameter between right and left temporal lines on the frontal bone (H.C.). Wood-Jones's No. 4; Martin's No. 9.

13. Bizygomatic Breadth. Facial breadth was taken as the greatest distance between points on the external surface of the zygomatic arches (H.C.). Wood-Jones's No. 1; Martin's No. 45.

14. Upper Facial Height. Measured as the distance between nasion and prosthion (S.C.). Wood-Jones's No. 2.

15. Upper Facial Index: $\dfrac{\text{upper facial height}=14}{\text{bizygomatic breadth}=13}$ x 100.

16. Total Facial Height. This was taken as the distance from the nasion to the gnathion or menton (median point on the inferior margin of the symphysis) (S.C.). Wood-Jones's No. 1; Martin's No. 47.

17. Total Facial Index: $\dfrac{\text{total facial height}}{\text{bizygomatic breadth}}$ x 100.

18. Orbital Breadth. Orbital breadth was interpreted as the maximum width of the orbit from the maxillofrontale (point upon the inner orbital wall at which the frontal, ascending process of the maxilla, and anterior lacrimal crest meet) to the middle of the lateral border of the orbit (S.C.). Martin's No. 51.

19. Orbital Height. The height of the orbit was taken as the maximum distance perpendicular to the plane of the superior and inferior borders of the orbit (S.C.). Wood-Jones's No. 2.

20. Orbital Index: calculated from the formula: $\dfrac{\text{orbital height}=19}{\text{orbital breadth}=18}$ x 100.

21. Nasal Breadth: the distance obtained as the greatest diameter of the lateral border of the nasal aperture measured in a horizontal plane (S.C.). Wood-Jones's No. 2; Martin's No. 54.

22. Nasal Height. The height of the nasal region was taken as the distance from the nasion to the mid point of a line connecting the right and left nasal fossae. Wood-Jones's No. 1; Martin's No. 55.

23. Nasal Index: $\dfrac{\text{nasal breadth}=21}{\text{nasal height}=22}$ x 100.

24. Maxillo-alveolar Breadth. This palatal measurement was obtained by measuring the maximum transverse separation of the alveolar arch lateral to the molar teeth (S.C.). Wood-Jones's No. 1; Martin's No. 61.

25. MAXILLO-ALVEOLAR LENGTH: the distance as measured from the prosthion to the middle of a transverse line connecting the posterior extremities of the alveolar border (S.C.). Wood-Jones's No. 2; Martin's No. 60.

26. MAXILLO-ALVEOLAR INDEX: $\dfrac{\text{breadth}=24}{\text{length}=25} \times 100.$

27. BIGONIAL DIAMETER: the distance measured from the lateral margins of one gonion to the other (vertex of angle between ramus and body of mandible) (S.C.). Wood-Jones's No. 2; Martin's No. 66.

28. SYMPHYSIS HEIGHT: the mandibular measurement taken inferiorly from the gnathion to the highest point of the alveolar border between the medial incisors (S.C.). Wood-Jones's No. 5; Martin's No. 69.

29. RAMUS HEIGHT: the distance from the uppermost projection of the condyle to the gonion (S.C.). This mandibular measurement was often difficult to obtain due to the nondescript nature of the ramus-body junction, morphologically characterized as 'Rocker Jaw'. Wood-Jones's No. 3; Martin's No. 70.

30. RAMUS BREADTH. A minimum breadth of the ascending ramus was obtained by measuring the distance between the anterior and posterior borders of only the left ramus when both were present (S.C.). Wood-Jones's No. 4a; Martin's No. 71a.

31. MANDIBULAR LENGTH. By aligning the mandible at the condyles posteriorly and at the symphysis anteriorly and taking that distance (condyle-symphyseal length) a measure of mandible length is obtained. Again, in cases of 'Rocker Jaw', this measurement was difficult and results tentative.

32. BICONDYLAR WIDTH. The width between the condyles is taken as the distance separating their external surfaces (S.C.). Wood-Jones's No. 1; Martin's No. 65.

## INDIVIDUAL CRANIAL VAULT MEASUREMENTS OF TONGAN MALES

| | CRANIAL | | | | | INDICES | | | FACIAL | | | | | | | | | ORBITAL | | | NASAL | | | ALVEOLAR | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Length | Breadth | Height | Capacity | Module | Cranial | Length-height | Breadth-height | Basion-nasion | Basion-prosthion | Gnathic index | Minimum frontal | Bizygomatic diam. | Upper facial ht. | Upper facial index | Total facial ht. | Total facial index | Breadth | Height | Index | Breadth | Height | Index | Breadth | Height | Index |
| To-At-1-6 | 174 | 155 | 147 | 1415.5 | 158.7 | 89.1 | 84.5 | 94.8 | 106 | 99 | 107.1 | 107 | 145 | 75 | 51.7 | — | — | 47 | 39 | 83.0 | 28 | 62 | 45.2 | 68 | 53 | 128.3 |
| To-At-1-7 | 186 | 170 | 141 | 1710.5 | 165.7 | 94.4 | 75.8 | 82.9 | 108 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-1-9 | 191 | 140 | 155 | 1627.1 | 162.0 | 73.7 | 81.2 | 110.7 | 111 | — | — | 89 | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-1-10 | 196 | — | — | — | — | — | — | — | — | — | — | 110 | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-1-19 | 175 | 130 | 140 | 1371.8 | 148.3 | 74.3 | 80 | 107.7 | — | — | — | 105 | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-1-21A | 175* | — | — | — | — | — | — | — | — | — | — | 112 | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-6 | 181* | 140 | — | — | — | 77.3 | — | — | — | — | — | 98 | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-13 | 177 | 145 | 145 | 1514.5 | 155.7 | 81.9 | 81.9 | 100 | 110 | 108 | 101.9 | 106 | 140 | 66 | 47.1 | 120 | 85.7 | 45 | 36 | 80.0 | 29 | 51 | 56.9 | 64 | 61 | 105.0 |
| To-At-2-13A | 178 | 138 | 141 | 1445.9 | 152.3 | 77.5 | 79.2 | 102.2 | 108 | 104 | 103.8 | 95 | 143 | 65 | 45.5 | 113 | 79.0 | 46 | 32 | 69.6 | 28 | 53 | 52.8 | 62 | 56 | 110.7 |
| To-At-2-31 | 191 | 141 | — | — | — | 73.8 | — | — | — | — | — | 96 | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-33 | — | 144 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-41 | 196 | 142 | — | — | — | 72.4 | — | — | — | — | — | 110 | — | — | — | — | — | — | — | — | — | — | — | — | 42 | — |
| MS1 | 185 | 137 | — | — | — | 74.1 | — | — | — | — | — | 102 | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| ? | 175 | 134 | — | — | — | 76.6 | — | — | — | — | — | 100 | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| MM2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 68 | 63 | 107.9 |

* An approximate value.

## INDIVIDUAL CRANIAL VAULT MEASUREMENTS OF TONGAN FEMALES

| | CRANIAL | | | | | INDICES | | | FACIAL | | | | | | | | | ORBITAL | | | NASAL | | | MAX-ALVEOLAR | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Length | Breadth | Height | Capacity | Module | Cranial | Length-height | Breadth-height | Basion-nasion | Basion-prosthion | Gnathic index | Minimum frontal | Bizygomatic height | Upper facial ht. | Upper facial index | Total facial ht. | Total facial index | Breadth | Height | Index | Breadth | Height | Index | Breadth | Height | Index |
| To-At-2-1C | 170 | 123 | 138 | 1262.2 | 143.7 | 72.4 | 81.2 | 112.2 | 101 | — | — | 90 | — | — | — | — | — | — | — | — | — | — | — | 66 | 55 | 120.0 |
| To-At-2-24A | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 55 | — | — |
| To-At-2-40A | 171* | 131* | — | — | — | 76.6 | — | — | — | — | — | 103 | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-MS3 | 181 | 137 | — | — | — | 75.7 | — | — | — | — | — | 100* | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-MS4 | 171 | 143 | 144 | 1361.3 | 152.7 | 83.6 | 84.2 | 100.7 | 110 | — | — | 101 | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-MS5 | 170 | — | — | — | — | — | — | — | — | — | — | 94 | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

* An approximate value.

### INDIVIDUAL MANDIBULAR MEASUREMENTS FOR MALE AND FEMALE TONGANS

| | Bigonial diameter | Symphysis height | Ramus height | Ramus breadth | Mandibular length | Bicondylar width |
|---|---|---|---|---|---|---|
| MALE | | | | | | |
| To-At-1-6 | 106* | 28 | 70 | 37 | 102 | — |
| To-At-1-7 | 88 | 28 | 59 | 39 | — | 127 |
| To-At-1-9 | 112 | 34 | 65 | 38 | 108* | — |
| To-At-1-10 | 94 | 27 | 56 | 38 | 114 | 116 |
| To-At-1-11 | 91 | 31 | 54 | 38 | 113 | 124 |
| To-At-1-29 | 115 | 33 | 75 | 42 | 116 | 137 |
| To-At-1-34 | 108 | 24 | 66 | 43 | 111 | 134 |
| To-At-2-6 | 100 | 31 | 54 | 32 | 112 | — |
| To-At-2-13 | 103 | 31 | 51 | 38 | 111 | 130 |
| To-At-2-13A | 106 | 28 | 64 | 35 | 107 | 124 |
| To-At-2-18 | 91 | 26* | 61 | 30 | 101 | 127* |
| To-At-2-31 | 95 | 34 | 66 | 40 | 107 | 126 |
| To-At-2-33 | — | 29 | 63 | 37 | 107 | 114 |
| To-At-2-41 | 115* | 35 | 65 | 46 | 106* | 135* |
| To-At-MA1 | 103 | 35 | 60 | 34 | 115 | 124 |
| To-At-MM2 | 107 | 28 | 68 | 40 | 109 | 138 |
| M1 | 94 | 28 | 61 | 36 | 114 | 122* |
| MM5 | 92 | 29 | 45 | 33 | 90 | 109 |
| FEMALE | | | | | | |
| To-At-1-4A | — | — | 68* | 40 | — | — |
| To-At-1-19 | — | — | 62 | 38 | — | — |
| To-At-1-20 | 93 | 34 | 66 | 42 | 118 | — |
| To-At-1-21B | — | 27 | — | — | — | — |
| To-At-1-27 | 101 | 32 | 51 | 34 | 103 | 121 |
| To-At-2-1C | 95 | 30 | 65 | 36 | 111* | — |
| To-At-2-24A | — | 30 | — | — | — | — |
| To-At-2-24B | — | 31 | — | 33 | — | — |
| To-At-2-25 | 94 | 26 | 59 | 36 | 104 | — |
| To-At-2-40A | 98 | 28 | 60 | 34 | 105 | 132 |

* An approximate value.

## APPENDIX 2

1. Description of infracranial measurements taken.
2. Individual infracranial measurements of adult and subadult material.

### INFRACRANIAL MEASUREMENTS AND INDICES

Infracranial measurements and their derived indices made in this study are outlined in this section. References to recognised schemata of osteometry are appended after each entry as in Appendix 1. The maximum lengths of the long bones were determined by use of an osteometric board (O.B.).

#### CLAVICLE

1. Maximum or Direct Length. This measurement was taken as the greatest length between the sternal and acromial extremities of the clavicle (O.B.). Wood-Jones's No. 1; Martin's No. 1.

HUMERUS

2. Maximum Length. Maximum lengths of all long bones were determined by placing them on the osteometric board in anatomical position and then pivoting them at their proximal extremities until a maximum length parallel to the board's surface was achieved (O.B.). Wood-Jones's No. 6; Martin's No. 1.

3. Minimum or Transverse Head Diameter: the transverse diameter of the proximal articular surface of the humerus (S.C.). Wood Jones's No. 12; Martin's No. 9.

4. Maximum or Sagittal Head Diameter: similar to the above measurement except that it is the vertical diameter of the humeral head. Wood-Jones's No. 11; Martin's No. 10.

ULNA

5. Maximum Length: (O.B.). Wood-Jones's No. 18; Martin's No. 1.

RADIUS

6. Maximum Length: (O.B.). Wood-Jones's No. 15; Martin's No. 1.

7. Radial Head Diameter: (S.C.). Taken as the maximum diameter of the radius head (Montagu 1960, p. 620). Montagu's No. 2.

FEMUR

8. Maximum Length: the maximum distance between the extremities of the femoral head and internal condyle (O.B.). Wood-Jones's No. 15; Martin's No. 1.

9. Maximum Head Diameter: (S.C.). Wood-Jones's No. 30; Martin's No. 15.

10. Subtrochanteric Antero-Posterior (A-P) Diameter: the sagittal diameter of the shaft taken at right angles to the long axis just below the "lesser trochanteric" protrusion (S.C.). Wood-Jones's No. 29; Martin's No. 10; Montagu's No. 16.

11. Subtrochanteric Lateral (Lat.) Diameter: transverse diameter, maximum diameter, or the medio-lateral diameter of the shaft at the subtrochanteric level. Difficulty is sometimes experienced in taking these diameters owing to the irregularities of this region in Polynesian skeletal remains—the so-called "platymeric protrusion" (Schofield 1959, p. 95). Wood-Jones's No. 28; Martin's No. 9; Montagu's No. 17.

12. Platymeric Index. This index is found by using the formula:

$$\frac{\text{subtrochanteric (A-P) diameter}=10}{\text{subtrochanteric (Lat.) diameter}=11} \times 100.$$

13. Antero-Posterior Diameter. This measurement is taken at the mid point of the femur's maximum length (S.C.). Wood-Jones's No. 25; Martin's No. 6; Montagu's No. 19.

14. Lateral (Transverse) Diameter. The *linea aspera* is kept midway between the arms of the calipers in taking this measurement (S.C.). Wood-Jones's No. 26; Martin's No. 7; Montagu's No. 20.

15. Pilastric Index: $$\frac{\text{A-P diameter}=13}{\text{Lat. (trans) diameter}=14} \times 100.$$

TIBIA

16. Maximum Length. This includes the spine and "medial malleolus" (O.B.). Wood-Jones's No. 37; Martin's No. 1a.

17. Transverse Diameter of Shaft. The diameter was taken at the level of the nutrient foramen (S.C.). Wood-Jones's No. 43.

18. Antero-Posterior Diameter of the Shaft: taken in a sagittal plane at the level of the nutrient foramen (S.C.). Wood-Jones's No. 44.

19. Platycnemic Index (Cnemic index): $\frac{\text{transverse diameter}=17}{\text{A-P diameter}=18} \times 100.$

FIBULA

20. Maximum Length. The "lateral malleolus" was included in this measurement (S.C.). Wood-Jones's No. 47; Martin's No. 1.

PATELLA

21. Height: maximum vertical diameter (S.C.). Wood-Jones's No. 34; Martin's No. 1.

22. Width: maximum transverse diameter (S.C.). Wood-Jones's No. 35; Martin's No. 2.

23. Thickness: maximum thickness (S.C.). Wood-Jones's No. 36; Martin's No. 3.

24. Patella Module: $\frac{\text{height}=21 + \text{width}=22 + \text{thickness}=23}{3}$

LUMBAR VERTEBRAE

25. Posterior Height: height measurement taken on the posterior half of the vertebral body, or more precisely the distance between the middle of the posterior-superior border and the middle of the posterior-inferior border of the centrum (S.C.) (Montagu 1960, p. 625). Martin's No. 2; Montagu's No. 30.

26. Anterior Height of the Centrum: taken from the middle of the anterior-superior border to the middle of the anterior-inferior lip of the centrum (S.C.). (op. cit.). Martin's No. 1; Montagu's No. 29.

27. Lumbar Index: $\frac{\text{posterior height of the centrum}=25}{\text{anterior height of the centrum}=26} \times 100$

(Anderson 1963, p. 125).

28. Lumbar Vertebral Index: $\frac{\text{sum of posterior heights of centra}}{\text{sum of anterior heights of centra}} \times 100$

(op. cit., p. 126).

29. Radio-Humeral Index (Brachial index): $\frac{\text{maximum length of radius}=6}{\text{maximum length of humerus}=2} \times 100$

30. Intermembral Index: $\frac{\text{length of humerus}=2 + \text{radius}=6}{\text{length of tibia}=16 + \text{femur}=8} \times 100$

31. Tibia-Femur Index (Crural index): $\frac{\text{tibia length}=16}{\text{femur length}=8} \times 100$

32. Femur-Humeral Index: $\frac{\text{length of humerus}=2}{\text{length of femur}=8} \times 100$

33. Tibia-Radial Index: $\frac{\text{length of radius}=6}{\text{length of tibia}=16} \times 100$

## INDIVIDUAL MEASUREMENTS OF TONGAN MALE INFRACRANIAL REMAINS (1)

| | CLAVICLE | | HUMERUS | | | | | | ULNA | | RADIUS | | | | FEMUR | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Length | | Length | | Min.hd.di. | | Max.hd.di. | | Length | | Length | | Hd.di. | | Length | | Hd.di. | | R.Subtrochanteric diameter | | Platymeric index |
| | R | L | R | L | R | L | R | L | R | L | R | L | R | L | R | L | R | L | A-P | Lat. | |
| To-At-1-6 | 144 | 149 | — | 320 | 44 | 44 | 46 | 49 | 272 | 269 | 255 | 252 | 24 | 23 | 460 | 462 | 47 | 47 | 29 | 34 | 85.3 |
| To-At-1-7 | — | — | — | 309 | — | — | — | 46 | 261 | — | — | 237 | — | 24 | — | — | 47 | — | 24 | 33 | 72.7 |
| To-At-1-10 | 130 | 132 | 334 | 332 | 43 | — | 48 | 47 | 270 | — | 254 | 254 | 22 | 23 | — | 443 | — | 46 | — | — | — |
| To-At-1-10B | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 474 | 457 | 48 | 48 | 28 | 35 | 80.0 |
| To-At-1-12 | — | — | — | — | 43 | — | 46 | — | 271 | — | — | 249 | — | 24 | — | — | 47 | 48 | 26 | 27 | 96.3 |
| To-At-1-21A | — | — | — | 330 | — | 42 | — | 41 | — | — | — | — | 25 | 26 | — | 474 | — | 49 | — | — | — |
| To-At-1-29 | — | — | 331 | 336 | 42 | 42 | 48 | 48 | 286 | 260 | — | — | — | — | 449 | 449 | — | 48 | 28 | 34 | 82.4 |
| To-At-1-31 | — | — | — | — | — | — | — | — | — | — | — | — | 25 | — | — | — | 50 | — | 28 | 32 | 87.5 |
| To-At-1-34 | 150 | — | 328 | — | 43 | — | 46 | — | 281 | — | 261 | — | 24 | — | 462 | — | 50 | — | 30 | 32 | 93.8 |
| To-At-2-5 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-6 | 136 | 134 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-13 | — | 142 | — | 320 | 43 | 42 | 45 | 46 | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-13A | 142 | *139 | 322 | 319 | 43 | 44 | 46 | 46 | 252 | 250 | 241 | 239 | 24 | 24 | — | — | — | — | — | — | — |
| To-At-2-13C | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-22 | — | 140 | 324 | 326 | — | 41 | 42 | 42 | 262 | 254 | 240 | 241 | 22 | 22 | — | — | — | — | — | — | — |
| To-At-2-22A | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-31 | 146 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 455 | — | 50 | — | — | — |
| To-At-2-33 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-35 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-37 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-42 | 134 | — | 309 | 308 | 39 | — | 44 | 42 | — | — | — | — | 22 | — | — | — | 46 | 46 | 25 | 31 | 80.6 |
| To-At-2-44 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

* An approximate value.

## INDIVIDUAL MEASUREMENTS OF TONGAN MALE INFRACRANIAL REMAINS (2)

| | FEMUR | | | | | | | | | TIBIA | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | L di. & index | | | R ½ di. & index | | | L ½ di. & index | | | Length | | R di. & index | | | L di. & index | | |
| | A-P | Lat. | Platymeric | Tran. | A-P | Pilastric | Tran. | A-P | Pilastric | R | L | Tran. | A-P | Platycnemic | Tran. | A-P | Platycnemic |
| To-At-1-6 | 29 | 37 | 78.4 | 26 | 32 | 123.1 | 26 | 32 | 123.1 | 383 | 383 | 27 | 39 | 69.2 | 27 | 39 | 69.2 |
| To-At-1-7 | 25 | 33 | 75.8 | 27 | 29 | 107.4 | 27 | 27 | 100.0 | — | 350 | — | — | — | 23 | 33 | 69.7 |
| To-At-1-9 | 26 | 33 | 78.8 | — | — | — | 28 | 31 | 110.7 | 363 | — | 25 | 39 | 64.1 | — | — | — |
| To-At-1-10 | — | — | — | 25 | 34 | 136.0 | — | — | — | — | — | 31 | 41 | 75.6 | — | — | — |
| To-At-1-10B | 28 | 33 | 84.4 | 29 | 29 | 100.0 | 27 | 33 | 122.2 | — | — | — | — | — | — | — | — |
| To-At-1-12 | 27 | 32 | 84.4 | — | — | — | 27 | 29 | 107.4 | 391 | — | 27 | 39 | 69.2 | 26 | 37 | 70.3 |
| To-At-1-21A | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-1-29 | 30 | 34 | 88.8 | 26 | 36 | 138.5 | 30 | 36 | 120.0 | 391 | — | 29 | 44 | 65.9 | 30 | 44 | 68.2 |
| To-At-1-31 | — | — | — | 28 | 30 | 107.1 | — | — | — | — | — | 24 | 36 | 66.7 | — | — | — |
| To-At-1-34 | — | — | — | 30 | 37 | 123.3 | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-5 | — | — | — | — | — | — | — | — | — | 398 | 395 | 21 | 42 | 50.0 | 21 | 43 | 48.8 |
| To-At-2-6 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-13 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-13A | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-13C | — | — | — | 25 | 29 | 116.0 | 25 | 27 | 100.8 | — | — | — | — | — | — | — | — |
| To-At-2-22 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-22A | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 21 | 35 | 60.0 |
| To-At-2-31 | 26 | 31 | 83.9 | — | — | — | 26 | 32 | 123.1 | — | — | — | — | — | — | — | — |
| To-At-2-33 | — | — | — | 26 | 27 | 103.8 | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-35 | — | — | — | 25 | 30 | 120.0 | — | — | — | — | — | 24 | 34 | 70.6 | 26 | 36 | 72.2 |
| To-At-2-37 | — | — | — | — | — | — | — | — | — | 383 | — | 24 | 38 | 63.2 | 24 | 35 | 68.6 |
| To-At-2-42 | 25 | 31 | 80.6 | — | — | — | — | — | — | — | — | — | — | — | 27 | 42 | 64.3 |
| To-At-2-44 | — | — | — | 29 | 32 | 110.3 | — | — | — | — | — | — | — | — | 25 | 37 | 67.6 |

## INDIVIDUAL MEASUREMENTS OF TONGAN MALE INFRACRANIAL REMAINS (3)

| | FIBULA Length | | R PATELLA | | | | L PATELLA | | | | LUMBAR VERTEBRAE L1 | | | L2 | | | L3 | | | L4 | | | L5 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | R | L | Lg. | Wd. | Ht. | Mod. | Lg. | Wd. | Ht. | Mod. | Post. | Ant. | Index | Post. | Ant. | Index | Post. | Ant. | Index | Post. | Ant. | Index | Post. | Ant. | Index |
| To-At-1-6 | 373 | 373 | 45 | 42 | 22 | 3.6 | 44 | 43 | 21 | 3.6 | 29 | 25 | 116.0 | 30 | 25 | 120.0 | 30 | 27 | 111.1 | 28 | 28 | 100.0 | 28 | 29 | 96.5 |
| To-At-1-7 | — | — | 44 | 44 | 20 | 3.6 | 44 | 45 | 21 | 3.7 | 29 | — | — | 29 | 26 | 111.5 | 28 | 26 | 107.7 | 28 | 26 | 107.7 | 26 | 27 | 96.3 |
| To-At-1-9 | — | — | — | — | — | — | — | — | — | — | — | — | — | 27 | 25 | 108.0 | 30 | 26 | 115.4 | 27 | — | — | 27 | 25 | 108.0 |
| To-At-1-10 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 26 | 26 | 100.0 | — | — | — | — | — | — |
| To-At-1-10B | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-1-12 | — | — | 46 | 47 | 20 | 3.8 | 46 | 49 | 22 | 3.9 | 25 | 24 | 104.2 | 27 | 24 | 112.5 | 26 | — | — | 26 | — | — | 26 | 27 | 96.3 |
| To-At-1-21A | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-1-29 | 381 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-1-31 | — | — | 41 | 44 | 22 | 3.6 | 42 | 46 | 23 | 3.7 | — | — | — | — | — | — | — | — | — | — | — | — | 25 | 30 | 83.3 |
| To-At-1-34 | — | — | 42 | 45 | 21 | 3.6 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 26 | 30 | 86.7 |
| To-At-2-5 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-6 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-13 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-13A | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-13C | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-18 | — | — | — | — | — | — | — | — | — | — | 26 | 24 | 108.3 | 27 | — | — | 26 | 25 | 104.0 | 24 | 25 | 96.0 | — | — | — |
| To-At-2-22 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-22A | — | 386 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-31 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-33 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 26 | 24 | 108.3 | 25 | 24 | 104.2 | 24 | 24 | 100.0 |
| To-At-2-35 | — | — | 41 | 42 | 19 | 3.4 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-37 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-42 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 26 | 26 | 100.0 | 25 | 27 | 92.6 | 25 | 22 | 92.6 |
| To-At-2-44 | — | — | 48 | 46 | 23 | 3.9 | 46 | 46 | 23 | 3.8 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

## INDIVIDUAL MEASUREMENTS OF TONGAN FEMALE INFRACRANIAL REMAINS (1)

| | CLAVICLE | | HUMERUS | | | | | | ULNA | | RADIUS | | | | FEMUR | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Length | | Length | | Min.hd.di. | | Max.hd.di. | | Length | | Length | | Hd.di. | | Length | | Hd.di. | | R.Subtrochanteric diameter | | Platymeric index |
| | R | L | R | L | R | L | R | L | R | L | R | L | R | L | R | L | R | L | A-P | Lat. | |
| To-At-1-11 | — | 140 | 325 | 321 | 39 | 39 | 42 | 42 | — | — | — | — | — | 24 | — | — | 44 | — | 28 | 31 | 90.3 |
| To-At-1-13 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 26 | 34 | 76.5 |
| To-At-1-19 | — | — | — | 322 | — | 38 | — | 39 | 256 | — | — | — | 20 | — | 458 | 461 | 44 | 45 | 26 | 31 | 83.9 |
| To-At-2-1C | 142 | — | 311 | — | 35 | — | 40 | — | 230 | — | 205 | — | 20 | — | — | — | — | — | — | — | — |
| To-At-2-4 | 152 | 154 | 359 | 360 | 44 | 44 | 48 | 50 | 275 | 280 | 260 | 258 | 28 | 27 | 512 | 509 | 52 | 52 | 27 | 33 | 81.8 |
| To-At-2-10 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-16 | — | — | 297 | — | — | — | 41 | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-20 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 46 | 46 | 23 | 35 | 65.7 |
| To-At-2-21 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-23 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 24 | 31 | 77.4 |
| To-At-2-25 | 131 | 128 | — | — | — | 39 | — | 36 | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-27 | — | — | 342 | — | 45 | — | 49 | — | — | — | — | — | — | — | — | — | — | — | 31 | 35 | 88.6 |
| To-At-2-27A | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 419 | 41 | 42 | 24 | 32 | 75.0 |
| To-At-2-30 | — | — | — | — | 39 | 42* | 41 | 43* | 263 | 258 | — | 230 | — | 21 | 423 | — | 44 | — | 25 | 32 | 78.1 |
| To-At-2-34 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-40A | 137* | 129 | 302 | — | 37 | 37 | 40 | 41 | 239 | — | 222 | — | — | — | — | — | — | — | — | — | — |

* An approximate value.

## INDIVIDUAL MEASUREMENTS OF TONGAN FEMALE INFRACRANIAL REMAINS (2)

| | FEMUR | | | | | | | | | TIBIA | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | L di. & index | | | R ½ di. & index | | | L ½ di. & index | | | Length | | R di. & index | | | L di. & index | | |
| | A-P | Lat. | Platymeric | Tran. | A-P | Pilastric | Tran. | A-P | Pilastric | R | L | Tran. | A-P | Platycnemic | Tran. | A-P | Platycnemic |
| To-At-1-11 | — | — | — | — | — | — | 25 | 25 | 100.0 | — | — | 27 | 34 | 79.4 | 26 | 34 | 76.5 |
| To-At-1-13 | 23 | 31 | 74.9 | 24 | 30 | 125.0 | 23 | 28 | 121.7 | — | — | — | — | — | — | — | — |
| To-At-1-19 | 28 | 30 | 93.3 | 27 | 29 | 107.4 | 27 | 28 | 103.7 | — | 380 | 26 | 36 | 72.2 | 26 | 36 | 72.2 |
| To-At-2-1C | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-4 | 26 | 33 | 98.8 | 28 | 31 | 110.7 | 28 | 30 | 107.1 | 412 | 419 | 22 | 39 | 56.4 | 23 | 40 | 57.5 |
| To-At-2-10 | — | — | — | — | — | — | — | — | — | — | — | 28 | 38 | 73.7 | — | — | — |
| To-At-2-16 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-20 | 23 | 35 | 65.7 | 26 | 30 | 115.4 | 26 | 28 | 107.7 | 381 | — | 24 | 36 | 66.7 | 26 | 37 | 70.3 |
| To-At-2-21 | — | — | — | — | — | — | — | — | — | — | — | 24 | 34 | 70.6 | 24 | 36 | 66.7 |
| To-At-2-23 | — | — | — | 25 | 27 | 108.0 | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-25 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-27 | — | — | — | 29 | 34 | 117.2 | 29 | 34 | 117.2 | 394 | — | 29 | 40 | 72.5 | — | — | — |
| To-At-2-27A | — | — | — | — | — | — | 25 | 28 | 112.0 | — | — | — | — | — | 24 | 33 | 72.7 |
| To-At-2-30 | 25 | 35 | 71.4 | 34 | 27 | 112.5 | 25 | 27 | 108.0 | — | 357 | — | — | — | 27 | 37 | 73.0 |
| To-At-2-34 | — | — | — | — | — | — | — | — | — | — | — | 25 | 34 | 73.5 | 25 | 33 | 75.8 |
| To-At-2-40A | — | — | — | — | — | — | 27 | 32 | 118.5 | — | — | — | — | — | — | — | — |

## INDIVIDUAL MEASUREMENTS OF TONGAN FEMALE INFRACRANIAL REMAINS (3)

| | FIBULA | | R PATELLA | | | | L PATELLA | | | | LUMBAR VERTEBRAE | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Length | | | | | | | | | | L1 | | | L2 | | | L3 | | | L4 | | | L5 | | |
| | R | L | Lg. | Wd. | Ht. | Mod. | Lg. | Wd. | Ht. | Mod. | Post. | Ant. | Index | Post. | Ant. | Index | Post. | Ant. | Index | Post. | Ant. | Index | Post. | Ant. | Index |
| To-At-1-11 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-1-13 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-1-19 | — | — | 40 | 43 | 20 | 3.4 | 40 | 42 | 20 | 3.4 | 30 | 29 | 103.4 | 30 | 30 | 100.0 | 26 | 30 | 86.7 | 31 | 28 | 110.7 | 29 | 29 | 100.0 |
| To-At-2-1C | — | — | — | — | — | — | — | — | — | — | 28 | 24 | 116.7 | 28 | 28 | 100.0 | 27 | 27 | 100.0 | 25 | 28 | 89.3 | 25 | 26 | 96.2 |
| To-At-2-4 | 347 | 399 | 49 | 49 | 21 | 4.0 | 49 | 49 | 21 | 4.0 | 30 | 27 | 111.1 | 30 | 28 | 107.1 | 29 | 27 | 107.4 | 28 | 28 | 100.0 | 26 | 29 | 89.7 |
| To-At-2-10 | — | — | 44 | 42 | 20 | 3.5 | 42 | 42 | 21 | 3.5 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-16 | — | — | — | — | — | — | — | — | — | — | 26 | 25 | 104.0 | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-20 | — | — | 38 | 40 | 20 | 3.3 | 39 | 40 | 20 | 3.3 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-21 | — | — | 37 | 40 | 20 | 3.2 | 36 | 40 | 19 | 3.2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-23 | — | — | — | — | — | — | 39 | 40 | 20 | 3.3 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-25 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-26 | — | — | — | — | — | — | — | — | — | — | 26 | 24 | 108.3 | 27 | 26 | 103.8 | 26 | 24 | 108.3 | 25 | 25 | 100.0 | 24 | 27 | 88.9 |
| To-At-2-27 | — | — | — | — | — | — | 44 | 46 | 21 | 3.7 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-27A | — | — | 36 | 35 | 19 | 3.0 | 37 | 38 | 19 | 3.1 | 26 | 24 | 108.3 | — | — | — | — | — | — | — | — | — | 24 | 25 | 96.0 |
| To-At-2-30 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-34 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-40A | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

## MAXIMUM LENGTHS OF THE SUBADULT INFRACRANIAL REMAINS

| | AGE | CLAVICLE | | HUMERUS | | ULNA | | RADIUS | | FEMUR | | TIBIA | | FIBULA | | PATELLA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | R | | | L | | |
| | | R | L | R | L | R | L | R | L | R | L | R | L | R | L | Ht. | Bd. | Th. | Ht. | Bd. | Th. |
| To-At-1-1B | 9 mos. | — | 61 | — | — | — | — | — | — | — | — | 98* | — | — | — | — | — | — | — | — | — |
| To-At-1-2 | 2-3 yrs. | — | — | — | 89 | — | — | — | — | — | — | 92 | 91 | 88 | 87 | — | — | — | — | — | — |
| To-At-1-3 | 2 yrs. | — | 58 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-1-5 | 0-6 mos. | — | — | — | 70 | — | 67 | — | — | 81 | 81 | 72 | 72 | 69 | 70 | — | — | — | — | — | — |
| To-At-1-16 | 0-6 mos. | — | — | — | 66 | — | 61 | — | — | 75 | 75 | 66 | 67 | 64 | — | — | — | — | — | — | — |
| To-At-1-17 | 0-8 mos. | — | 63 | — | — | 94 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-1-29C | 0-6 mos. | — | — | — | — | — | — | — | — | — | — | — | 85 | — | — | — | — | — | — | — | — |
| To-At-1-32 | 0-9 mos. | — | — | — | 97 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-1-35 | 6 mos. | 65 | — | 95 | 96 | 86 | 86 | 75 | 75 | 123 | 123 | — | — | — | — | — | — | — | — | — | — |
| To-At-1-36 | 2 yrs. | 65 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-1-37 | 7-8 yrs. | — | — | — | — | — | — | — | — | — | — | — | 177 | — | — | — | — | — | — | — | — |
| To-At-2-1A | 3 yrs. | — | 76 | 143 | 142 | 128 | — | — | — | 194 | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-2 | 0-6 mos. | 42 | — | 61 | — | 58 | — | 51 | 51 | 69 | — | 61 | 61 | — | — | — | — | — | — | — | — |
| To-At-2-7 | 1-2 yrs. | 60 | 59 | 99 | 100 | 85 | 96 | 76 | 78 | 122 | 124 | 104 | 104 | 98 | — | — | — | — | — | — | — |
| To-At-2-11 | 23 yrs. | 120 | 118 | 265 | 255 | 272 | 215 | 206 | 201 | 375 | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-17 | 0-1 yr. | — | — | — | — | — | 91 | — | 81 | — | — | — | — | — | — | — | — | — | — | — | — |
| To-At-2-19 | 22 yrs. | — | — | — | — | — | — | — | — | 446 | 440 | — | 355 | — | — | — | — | — | 44 | 43 | 19 |

* Intrusive.

## TABLE 1

## INDIVIDUAL AGE-GROUP ASSIGNMENT OF IMMATURE TONGANS, TO-AT-1 AND TO-AT-2

| | TO-AT-1 | TO-AT-2 |
|---|---|---|
| New born to 1 year | 1- 1B | 2- 1 |
| | 1- 5 | 2-14 |
| | 1- 8 | 2-17 |
| | 1-16 | |
| | 1-17 | |
| | 1-29C | |
| | 1-32 | |
| | 1-35 | |
| | 1-38 | |
| 1- 4 years | 1- 1A | 2- 1A |
| | 1- 2 | (2- 1E) |
| | 1- 3 | 2- 7 |
| | (1- 4C) | 2- 9 |
| | 1-18 | |
| | 1-25 | |
| | 1-29B | |
| | 1-36 | |
| 4- 8 years | 1-15 | 2- 3 |
| | 1-28 | 2-21B |
| | 1-37 | 2-36 |
| 12-18 years | 1-14 | 2- 1D |
| | 1-30 | (2- 1E) |
| | | 2-15 |
| | | 2-39 |

## TABLE 2

## INDIVIDUAL AGE-GROUP ASSIGNMENT ACCORDING TO SEX OF MATURE TONGANS

| | MALE | | FEMALE | | SEX ? | |
|---|---|---|---|---|---|---|
| Young adult | 1-34 | 2- 6 | 1-23 | 2-11 | | |
| | | 2-19 | | 2-16 | | |
| | | 2-31 | | | | |
| | | 2-33 | | | | |
| Middle aged | 1- 6 | 2-13 | | 2- 1C | | |
| | | 2-13A | | 2- 4 | | |
| | | | | 2-24B | | |
| Aged | 1- 7 | 2-18 | | 2-40A | | |
| | | 2-41 | | | | |
| Adult (not old) | 1- 9 | | | 2-25 | 1-19 | |
| | 1-10 | | | | | |
| | 1-20 | | | | | |
| Adult (?) | 1-12 | (2- 1E) | 1- 4A | 2-20 | 1- 4B | (2- 1E) |
| | 1-27 | 2- 5 | 1-11 | 2-21 | 1- 4C | 2-10 |
| | 1-29A | 2- 8 | 1-13 | 2-24A | 1-13C | 2-23 |
| | 1-31 | 2-13C | 1-26 | 2-26 | ‘1-19’ | 2-34 |
| | | 2-22 | | 2-27 | 1-21A | 2-35 |
| | | 2-22A | | 2-27A | 1-21B | 2-37 |
| | | 2-38 | | 2-28 | | 2-40B |
| | | 2-42 | | 2-30 | | |
| | | | | 2-32 | | |

## TABLE 3

## SUMMARY OF SUBADULT AND ADULT AGE-GROUPS PRESENT IN 'ATELE MOUNDS WITH REFERENCE TO SEX IF DETERMINED

| | TO-AT-1 | | TO-AT-2 | | TOTAL | |
|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % |
| Subadult (in years) | | | | | | |
| 0- 1 | 9 | 37.5 | 3 | 21.4 | 12 | 31.6 |
| 1- 4 | 8 | 33.3 | 4 | 28.6 | 12 | 31.6 |
| 4- 8 | 4 | 16.7 | 3 | 21.4 | 7 | 18.4 |
| 8-12 | | | | | | |
| 12-18 | 2 | 8.3 | 4 | 28.6 | 6 | 15.8 |
| 18-22 | 1 | 4.2 | | | 1 | 2.6 |
| Total | 24 | 100.0 | 14 | 100.0 | 38 | 100.0 |
| Adult | | | | | | |
| Young males | 1 | 50.0 | 4 | 66.7 | 5 | 62.5 |
| „ females | 1 | 50.0 | 2 | 33.3 | 3 | 37.5 |
| Total | 2 | 100.0 | 6 | 100.0 | 8 | 100.0 |
| Young and/or middle-aged males | 3 | 75.0 | | | 3 | 60.0 |
| „ „ „ females | | | 1 | 100.0 | 1 | 20.0 |
| Sex ? | 1 | 25.0 | | | 1 | 20.0 |
| Total | 4 | 100.0 | 1 | 100.0 | 5 | 100.0 |
| Middle-aged males | 1 | 100.0 | 2 | 40.0 | 3 | 50.0 |
| „ females | | | 3 | 60.0 | 3 | 50.0 |
| Total | 1 | 100.0 | 5 | 100.0 | 6 | 100.0 |
| Aged males | 1 | 100.0 | 2 | 66.7 | 3 | 75.0 |
| „ females | | | 1 | 33.3 | 1 | 25.0 |
| Total | 1 | 100.0 | 3 | 100.0 | 4 | 100.0 |
| Adult (?) males | 4 | 28.6 | 8 | 33.3 | 12 | 31.6 |
| „ „ females | 4 | 28.6 | 9 | 37.5 | 13 | 34.2 |
| Sex (?) | 6 | 42.8 | 7 | 29.2 | 13 | 34.2 |
| Total | 14 | 100.0 | 24 | 100.0 | 38 | 100.0 |
| Total adult | 22 | | 39 | | 61 | |
| Total adult + subadult | 46 | | 53 | | 99 | |
| Percentage of adults | | 47.8 | | 73.6 | | 61.6 |
| Percentage of subadults | | 52.2 | | 26.4 | | 38.4 |

## TABLE 4

## FREQUENCY OF MATURE TONGANS ACCORDING TO SEX

| | TO-AT-1 | | TO-AT-2 | | TOTAL | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Males | 10 | 45.5 | 16 | 41.0 | 26 | 42.6 |
| Females | 5 | 22.7 | 16 | 41.0 | 21 | 34.4 |
| Unknown | 7 | 31.8 | 7 | 18.0 | 14 | 23.0 |
| Total | 22 | 100.0 | 39 | 100.0 | 61 | 100.0 |

## TABLE 5

### CRANIAL VARIATION 1. FACIAL MORPHOLOGY

| TRAIT VARIATION | MALE/FEMALE | | | | TO-AT-1/TO-AT-2 | | | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | n | N | *% | | n | N | % | n | N | % |
| Metopic suture | | | | | | | | | | | |
| Presence | M | 11 | 0 | 0.0 | I | 6 | 0 | 0.0 | 24 | 0 | 0.0 |
| | F | 10 | 0 | 0.0 | II | 14 | 0 | 0.0 | | | |
| Persistent on brow only | M | — | 7 | 63.6 | | — | 5 | 83.3 | — | 15 | 62.5 |
| | F | — | 5 | 50.0 | | — | 6 | 42.9 | | | |
| Frontal bossing | | | | | | | | | | | |
| Median | M | 11 | 1 | 9.0 | I | 6 | 2 | 33.3 | 23 | 5 | 21.7 |
| | F | 9 | 2 | 22.2 | II | 14 | 2 | 14.3 | | | |
| Bilateral | M | — | 6 | 54.5 | | — | 3 | 50.0 | — | 14 | 60.9 |
| | F | — | 7 | 77.7 | | — | 9 | 64.3 | | | |
| Frontal grooves | | | | | | | | | | | |
| Per skull | M | 10 | 1 | 10.0 | I | 5 | 0 | 0.0 | 24 | 1 | 4.2 |
| | F | 10 | 0 | 0.0 | II | 15 | 1 | 6.7 | | | |
| R side only | M | 11 | 1 | 9.1 | | 4 | 0 | 0.0 | 23 | 1 | 4.3 |
| | F | 10 | 0 | 0.0 | | 15 | 1 | 6.7 | | | |
| L side only | M | 10 | 1 | 10.0 | | 5 | 0 | 0.0 | 23 | 1 | 4.3 |
| | F | 10 | 0 | 0.0 | | 14 | 1 | 7.1 | | | |
| **RL (per side) | M | 21 | 2 | 9.5 | | 9 | 0 | 0.0 | 46 | 2 | 4.3 |
| | F | 20 | 0 | 0.0 | | 29 | 2 | 6.9 | | | |
| Right supraorbital | | | | | | | | | | | |
| Foramen | M | 13 | 4 | 30.8 | I | 8 | 2 | 25.0 | 26 | 8 | 30.8 |
| | F | 10 | 3 | 30.0 | II | 14 | 5 | 35.7 | | | |
| Notch | M | — | 3 | 23.1 | | — | 2 | 25.0 | — | 3 | 11.5 |
| | F | — | 0 | 0.0 | | — | 1 | 7.1 | | | |
| Spurred notch | M | — | 6 | 46.2 | | — | 4 | 50.0 | — | 15 | 57.7 |
| | F | — | 7 | 70.0 | | — | 8 | 57.1 | | | |
| Left supraorbital | | | | | | | | | | | |
| Foramen | M | 10 | 3 | 30.0 | I | 6 | 1 | 16.7 | 20 | 5 | 25.0 |
| | F | 7 | 2 | 28.6 | II | 11 | 3 | 27.3 | | | |
| Notch | M | — | 1 | 10.0 | | — | 0 | 0.0 | — | 2 | 20.0 |
| | F | — | 1 | 14.3 | | — | 2 | 18.2 | | | |
| Spurred notch | M | — | 5 | 50.0 | | — | 5 | 83.3 | — | 12 | 60.0 |
| | F | — | 4 | 57.1 | | — | 5 | 45.5 | | | |
| Double foramen | M | — | 1 | 10.0 | | — | 0 | 0.0 | — | 1 | 5.0 |
| | F | — | 0 | 0.0 | | — | 1 | 9.1 | | | |
| Brow ridge | | | | | | | | | | | |
| No | M | 11 | 2 | 18.2 | I | 5 | 1 | 20.0 | 21 | 4 | 19.1 |
| | F | 8 | 0 | 0.0 | II | 12 | 3 | 25.0 | | | |
| Disc + | M | — | 0 | 0.0 | | — | 1 | 20.0 | — | 0 | 0.0 |
| | F | — | 1 | 12.5 | | — | 0 | 0.0 | | | |
| +V | M | — | 5 | 45.5 | | — | 4 | 80.0 | — | 12 | 57.1 |
| | F | — | 0 | 0.0 | | — | 4 | 33.3 | | | |
| ++V | M | — | 4 | 36.4 | | — | 0 | 0.0 | — | 5 | 23.8 |
| | F | — | 7 | 87.5 | | — | 5 | 41.7 | | | |
| Right infraorbital | | | | | | | | | | | |
| Two separate for. | M | 4 | 3 | 75.0 | I | 1 | 1 | 100.0 | 7 | 6 | 85.7 |
| | F | 1 | 1 | 100.0 | II | 5 | 4 | 80.0 | | | |
| Divided | M | — | 1 | 25.0 | | — | 0 | 0.0 | — | 1 | 14.3 |
| | F | — | 0 | 0.0 | | — | 1 | 20.0 | | | |
| Left infraorbital | | | | | | | | | | | |
| Two | M | 3 | 2 | 66.7 | I | 1 | 1 | 100.0 | 7 | 6 | 85.7 |
| | F | 1 | 1 | 100.0 | II | 5 | 4 | 80.0 | | | |
| Divided | M | — | 1 | 33.3 | | — | 0 | 0.0 | — | 1 | 14.3 |
| | F | — | 0 | 0.0 | | — | 1 | 20.0 | | | |
| Naso-frontal suture | | | | | | | | | | | |
| Angle | M | 9 | 2 | 22.2 | I | 3 | 1 | 33.3 | 13 | 3 | 23.1 |
| | F | 3 | 1 | 33.3 | II | 9 | 2 | 22.2 | | | |
| Omega | M | — | 2 | 22.2 | | — | 0 | 0.0 | — | 2 | 15.4 |
| | F | — | 0 | 0.0 | | — | 1 | 11.1 | | | |
| Fused laterally | M | — | 5 | 55.6 | | — | 2 | 66.7 | — | 8 | 61.5 |
| | F | — | 2 | 66.7 | | — | 6 | 66.7 | | | |

TABLE 5—Continued

| TRAIT VARIATION | MALE/FEMALE | | | | TO-AT-1/TO-AT-2 | | | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *n* | N | *% | | *n* | N | % | *n* | N | % |
| Nasal bone shape | | | | | | | | | | | |
| Rectangular | M | 2 | 0 | 0.0 | I | 0 | — | — | 3 | 0 | 0.0 |
| | F | 0 | — | — | II | 3 | 0 | 0.0 | | | |
| Triangular | M | — | 0 | 0.0 | | — | — | — | — | 0 | 0.0 |
| | F | — | — | — | | — | 0 | 0.0 | | | |
| Hour glass shaped | M | — | 2 | 100.0 | | — | — | — | — | 3 | 100.0 |
| | F | — | — | — | | — | 3 | 100.0 | | | |
| Subnasal region | | | | | | | | | | | |
| Sharp | M | 13 | 1 | 7.7 | I | 12 | 0 | — | 31 | 1 | 3.2 |
| | F | 10 | 0 | 0.0 | II | 12 | 0 | — | | | |
| Blurred | M | — | 11 | 84.6 | | — | 8 | 66.7 | | 23 | 74.2 |
| | F | — | 6 | 60.0 | | — | 10 | 83.3 | | | |
| Groove | M | — | 0 | 0.0 | | — | 0 | — | | 1 | 3.2 |
| | F | — | 1 | 10.0 | | — | 1 | 8.3 | | | |
| Sulcus | M | — | 1 | 7.7 | | — | 4 | 33.3 | | 6 | 19.4 |
| | F | — | 13 | 30.0 | | — | 1 | 8.3 | | | |
| Os Japonicum | | | | | | | | | | | |
| Per skull | M | 7 | 0 | 0.0 | I | 3 | 0 | 0.0 | 15 | 0 | 0.0 |
| | F | 6 | 0 | 0.0 | II | 11 | 0 | 0.0 | | | |
| R side | M | 6 | 0 | 0.0 | | 2 | 0 | 0.0 | 12 | 0 | 0.0 |
| | F | 4 | 0 | 0.0 | | 9 | 0 | 0.0 | | | |
| L side | M | 5 | 0 | 0.0 | | 3 | 0 | 0.0 | 12 | 0 | 0.0 |
| | F | 5 | 0 | 0.0 | | 9 | 0 | 0.0 | | | |
| RL (per side) | M | 11 | 0 | 0.0 | | 6 | 0 | 0.0 | 24 | 0 | 0.0 |
| | F | 9 | 0 | 0.0 | | 18 | 0 | 0.0 | | | |
| Right malar tuberosity | | | | | | | | | | | |
| + | M | 8 | 2 | 25.0 | I | 4 | 0 | 0.0 | 16 | 3 | 18.8 |
| | F | 6 | 0 | 0.0 | II | 11 | 3 | 27.3 | | | |
| ++ | M | — | 0 | 0.0 | | — | 0 | 0.0 | — | 0 | 0.0 |
| | F | — | 0 | 0.0 | | — | 0 | 0.0 | | | |
| +++ | M | — | 0 | 0.0 | | — | 0 | 0.0 | — | 0 | 0.0 |
| | F | — | 0 | 0.0 | | — | 0 | 0.0 | | | |
| Left malar tuberosity | | | | | | | | | | | |
| + | M | 6 | 1 | 16.7 | I | 4 | 0 | 0.0 | 13 | 2 | 15.4 |
| | F | 5 | 0 | 0.0 | II | 9 | 2 | 22.2 | | | |
| ++ | M | — | 0 | 0.0 | | — | 0 | 0.0 | — | 0 | 0.0 |
| | F | — | 0 | 0.0 | | — | 0 | 0.0 | | | |
| +++ | M | — | 0 | 0.0 | | — | 0 | 0.0 | — | 0 | 0.0 |
| | F | — | 0 | 0.0 | | — | 0 | 0.0 | | | |
| Right zygomaxillary tuberosity | | | | | | | | | | | |
| + | M | 6 | 3 | 50.0 | I | 3 | 1 | 33.3 | 14 | 5 | 35.7 |
| | F | 6 | 2 | 33.3 | II | 10 | 4 | 40.0 | | | |
| ++ | M | — | 0 | 0.0 | | — | 0 | 0.0 | — | 0 | 0.0 |
| | F | — | 0 | 0.0 | | — | 0 | 0.0 | | | |
| +++ | M | — | 0 | 0.0 | | — | 0 | 0.0 | — | 0 | 0.0 |
| | F | — | 0 | 0.0 | | — | 0 | 0.0 | | | |
| Left zygomaxillary tuberosity | | | | | | | | | | | |
| + | M | 5 | 3 | 60.0 | I | 3 | 2 | 66.7 | 12 | 5 | 41.7 |
| | F | 5 | 2 | 40.0 | II | 9 | 3 | 33.3 | | | |
| ++ | M | — | 1 | 20.0 | | — | 0 | 0.0 | — | 1 | 8.3 |
| | F | — | 0 | 0.0 | | — | 1 | 11.1 | | | |
| +++ | M | — | 0 | 0.0 | | — | 0 | 0.0 | — | 0 | 0.0 |
| | F | — | 0 | 0.0 | | — | 0 | 0.0 | | | |

* Percentages should be viewed with caution owing to the smallness of the sample sizes.

** Actually 2*n*.

## TABLE 6

## CRANIAL VARIATION 2. BASAL MORPHOLOGY

| TRAIT | VARIATION | MALE/FEMALE | | | | TO-AT-1/TO-AT-2 | | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *n* | N | % | *n* | N | % | *n* | N | % |
| Palatine torus | | | | | | | | | | | |
| | Presence | M | 8 | 0 | 0.0 | 5 | 0 | 0.0 | 18 | 1 | 5.6 |
| | | F | 5 | 0 | 0.0 | 9 | 1 | 11.1 | | | |
| Palatine suture | | | | | | | | | | | |
| | Straight | M | 5 | 0 | 0.0 | 4 | 0 | 0.0 | 9 | 0 | 0.0 |
| | | F | 2 | 0 | 0.0 | 4 | 0 | 0.0 | | | |
| | Ant. deflected | M | — | 5 | 100.0 | — | 4 | 100.0 | — | 9 | 100.0 |
| | | F | — | 2 | 100.0 | — | 4 | 100.0 | | | |
| Right ovale-spinosum | | | | | | | | | | | |
| | Normal | M | 6 | 6 | 100.0 | 4 | 4 | 100.0 | 7 | 7 | 100.0 |
| | | F | 0 | — | — | 3 | 3 | 100.0 | | | |
| Left ovale-spinosum | | | | | | | | | | | |
| | Normal | M | 8 | 8 | 100.0 | 6 | 6 | 100.0 | 12 | 12 | 100.0 |
| | | F | 2 | 2 | 100.0 | 6 | 6 | 100.0 | | | |
| Precondylar | | | | | | | | | | | |
| | Facet | M | 6 | 0 | 0.0 | 4 | 0 | 0.0 | 11 | 0 | 0.0 |
| | | F | 3 | 0 | 0.0 | 5 | 0 | 0.0 | | | |
| | Tuberosity | M | — | 0 | 0.0 | — | 0 | 0.0 | — | 1 | 9.1 |
| | | F | — | 1 | 33.3 | — | 1 | 20.0 | | | |
| | Double tuberosity | M | — | 1 | 16.7 | — | 1 | 25.0 | — | 1 | 9.1 |
| | | F | — | 0 | 0.0 | — | 0 | 0.0 | | | |
| Ossified apical | | | | | | | | | | | |
| | + | M | 6 | 0 | 0.0 | 4 | 0 | 0.0 | 11 | 1 | 9.1 |
| | | F | 3 | 1 | 33.3 | 5 | 1 | 20.0 | | | |
| | ++ | M | — | 1 | 16.7 | — | 1 | 25.0 | — | 1 | 9.1 |
| | | F | — | 0 | 0.0 | — | 0 | 0.0 | | | |
| | +++ | M | — | 0 | 0.0 | — | 0 | 0.0 | — | 0 | 0.0 |
| | | F | — | 0 | 0.0 | — | 0 | 0.0 | | | |
| Paramastoid | | | | | | | | | | | |
| | Per skull | M | 9 | 4 | 44.4 | 5 | 3 | 60.0 | 11 | 5 | 45.5 |
| | | F | 1 | 0 | 0.0 | 5 | 2 | 40.0 | | | |
| | R side | M | 6 | 3 | 50.0 | 2 | 2 | 100.0 | 5 | 4 | 80.0 |
| | | F | 1 | 0 | 0.0 | 5 | 2 | 40.0 | | | |
| | L side | M | 8 | 3 | 37.5 | 4 | 2 | 50.0 | 6 | 4 | 66.7 |
| | | F | 1 | 0 | 0.0 | 5 | 2 | 40.0 | | | |
| | RL (per side) | M | 14 | 6 | 42.9 | 6 | 4 | 66.7 | 11 | 8 | 72.7 |
| | | F | 2 | 0 | 0.0 | 10 | 4 | 40.0 | | | |
| Double ant. cond. canal | | | | | | | | | | | |
| | Per skull | M | 11 | 3 | 27.3 | 7 | 3 | 42.9 | 21 | 4 | 19.1 |
| | | F | 8 | 0 | 0.0 | 12 | 4 | 33.3 | | | |
| | R side | M | 7 | 1 | 14.3 | 5 | 0 | 0.0 | 18 | 1 | 5.6 |
| | | F | 7 | 0 | 0.0 | 12 | 4 | 33.3 | | | |
| | L side | M | 10 | 2 | 20.0 | 7 | 3 | 42.9 | 19 | 3 | 15.8 |
| | | F | 6 | 0 | 0.0 | 11 | 2 | 18.2 | | | |
| | RL (per side) | M | 17 | 2 | 11.8 | 12 | 3 | 25.0 | 37 | 4 | 10.8 |
| | | F | 13 | 0 | 0.0 | 23 | 6 | 26.1 | | | |
| Post. condylar canal | | | | | | | | | | | |
| | Per skull | M | 10 | 7 | 70.0 | 5 | 3 | 60.0 | 16 | 9 | 56.3 |
| | | F | 5 | 2 | 40.0 | 9 | 7 | 77.8 | | | |
| | R side | M | 8 | 4 | 50.0 | 3 | 2 | 66.7 | 12 | 6 | 50.0 |
| | | F | 3 | 1 | 33.3 | 8 | 4 | 50.0 | | | |
| | L side | M | 8 | 5 | 62.5 | 4 | 2 | 50.0 | 14 | 9 | 64.3 |
| | | F | 5 | 3 | 60.0 | 8 | 6 | 75.0 | | | |
| | RL (per side) | M | 16 | 9 | 56.3 | 7 | 4 | 57.1 | 26 | 15 | 57.7 |
| | | F | 8 | 4 | 50.0 | 16 | 10 | 62.5 | | | |

TABLE 6—Continued

| TRAIT | VARIATION | | MALE/FEMALE | | | TO-AT-1/TO-AT-2 | | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *n* | N | % | *n* | N | % | *n* | N | % |
| Occipital condyles | | | | | | | | | | | |
| | R1L1 | M | 10 | 6 | 60.0 | 6 | 4 | 66.7 | 20 | 12 | 60.0 |
| | | F | 8 | 4 | 50.0 | 12 | 6 | 50.0 | | | |
| | R2L2 | M | — | 1 | 10.0 | — | 0 | 0.0 | — | 1 | 5.0 |
| | | F | — | 0 | 0.0 | — | 1 | 8.3 | | | |
| | R1L2 | M | — | 1 | 10.0 | — | 1 | 16.7 | — | 1 | 5.0 |
| | | F | — | 0 | 0.0 | — | 0 | 0.0 | | | |
| | R1 | M | — | 1 | 10.0 | — | 0 | 0.0 | — | 2 | 10.0 |
| | | F | — | 1 | 12.5 | — | 2 | 16.7 | | | |
| | R2 | M | — | 0 | 0.0 | — | 0 | 0.0 | — | 2 | 10.0 |
| | | F | — | 2 | 25.0 | — | 2 | 16.7 | | | |
| | L1 | M | — | 1 | 10.0 | — | 1 | 16.7 | — | 0 | 0.0 |
| | | F | — | 0 | 0.0 | — | 1 | 8.3 | | | |
| | L2 | M | — | 0 | 0.0 | — | 0 | 0.0 | — | 2 | 10.0 |
| | | F | — | 1 | 12.5 | — | 0 | 0.0 | | | |
| Condylar arthritis | | | | | | | | | | | |
| | Per skull | M | 3 | 2 | 66.7 | 4 | 4 | 100.0 | 17 | 10 | 58.8 |
| | | F | 8 | 2 | 25.0 | 11 | 5 | 45.5 | | | |
| | R side | M | 2 | 1 | 50.0 | 3 | 3 | 100.0 | 15 | 9 | 60.0 |
| | | F | 7 | 2 | 28.6 | 10 | 5 | 50.0 | | | |
| | L side | M | 3 | 1 | 33.3 | 4 | 4 | 100.0 | 15 | 10 | 66.7 |
| | | F | 6 | 2 | 33.3 | 9 | 4 | 44.4 | | | |
| | RL (per side) | M | 5 | 2 | 40.0 | 7 | 7 | 100.0 | 33 | 19 | 57.6 |
| | | F | 13 | 4 | 30.8 | 19 | 9 | 47.4 | | | |
| INTERIOR | | | | | | | | | | | |
| Lateral sinus | | | | | | | | | | | |
| | To right | M | 11 | 9 | 82.0 | 7 | 6 | 85.7 | 23 | 19 | 82.6 |
| | | F | 9 | 7 | 77.8 | 12 | 10 | 83.3 | | | |
| | To left | M | — | 1 | 9.1 | — | 0 | 0.0 | — | 1 | 4.3 |
| | | F | — | 0 | 0.0 | — | 1 | 8.3 | | | |
| | Common | M | — | 1 | 9.1 | — | 1 | 14.3 | — | 3 | 13.0 |
| | | F | — | 2 | 22.2 | — | 1 | 8.3 | | | |

## TABLE 7

### CRANIAL VARIATION 3. MORPHOLOGY OF THE VAULT REGION

| TRAIT VARIATION | | MALE/FEMALE | | | TO-AT-1/TO-AT-2 | | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *n* | N | % | *n* | N | % | *n* | N | % |
| Coronal wormians | | | | | | | | | | |
| Presence | M | 11 | 0 | 0.0 | 6 | 0 | 0.0 | 22 | 0 | 0.0 |
| | F | 8 | 0 | 0.0 | 12 | 0 | 0.0 | | | |
| Sagittal wormians | | | | | | | | | | |
| Presence | M | 10 | 0 | 0.0 | 5 | 0 | 0.0 | 21 | 0 | 0.0 |
| | F | 9 | 0 | 0.0 | 12 | 0 | 0.0 | | | |
| Bregmatic bone | | | | | | | | | | |
| Presence | M | 11 | 0 | 0.0 | 3 | 0 | 0.0 | 21 | 0 | 0.0 |
| | F | 8 | 0 | 0.0 | 13 | 0 | 0.0 | | | |
| Lambdoid wormians | | | | | | | | | | |
| 1 | M | 12 | 1 | 8.3 | 2 | 1 | 50.0 | 23 | 1 | 4.3 |
| | F | 11 | 0 | 0.0 | 14 | 0 | 0.0 | | | |
| 2 | M | — | 0 | 0.0 | — | 0 | 0.0 | — | 0 | 0.0 |
| | F | — | 0 | 0.0 | — | 0 | 0.0 | | | |
| 3 | M | — | 0 | 0.0 | — | 1 | 50.0 | — | 3 | 13.0 |
| | F | — | 2 | 18.2 | — | 1 | 7.1 | | | |
| + | M | — | 3 | 25.0 | — | 0 | 0.0 | — | 5 | 21.7 |
| | F | — | 2 | 18.2 | — | 3 | 21.4 | | | |
| At Lambda | | | | | | | | | | |
| Os Inca | M | 12 | 1 | 8.3 | 4 | 0 | 0.0 | 23 | 1 | 4.3 |
| | F | 9 | 0 | 0.0 | 14 | 1 | 7.1 | | | |
| Trace | M | — | 1 | 8.3 | — | 0 | 0.0 | — | 1 | 4.3 |
| | F | — | 0 | 0.0 | — | 0 | 0.0 | | | |
| Lambdic bone | M | — | 0 | 0.0 | — | 0 | 0.0 | — | 0 | 0.0 |
| | F | — | 0 | 0.0 | — | 0 | 0.0 | | | |
| Bulge | M | — | 2 | 16.6 | — | 0 | 0.0 | — | 2 | 8.7 |
| | F | — | 0 | 0.0 | — | 1 | 7.1 | | | |
| Sagittal keel | | | | | | | | | | |
| + | M | 11 | 7 | 63.6 | 5 | 4 | 80.0 | 22 | 17 | 77.3 |
| | F | 8 | 7 | 87.5 | 13 | 9 | 69.2 | | | |
| ++ | M | — | 1 | 9.1 | — | 0 | 0.0 | — | 1 | 4.5 |
| | F | — | 0 | 0.0 | — | 1 | 7.7 | | | |
| +++ | M | — | 0 | 0.0 | — | 0 | 0.0 | — | 0 | 0.0 |
| | F | — | 0 | 0.0 | — | 0 | 0.0 | | | |
| Parietal bossing | | | | | | | | | | |
| + | M | 12 | 3 | 25.0 | 8 | 1 | 12.5 | 24 | 7 | 29.2 |
| | F | 9 | 4 | 44.4 | 12 | 4 | 33.3 | | | |
| ++ | M | — | 9 | 75.0 | — | 7 | 87.5 | — | 17 | 70.8 |
| | F | — | 5 | 55.6 | — | 8 | 66.7 | | | |
| +++ | M | — | 0 | 0.0 | — | 0 | 0.0 | — | 0 | 0.0 |
| | F | — | 0 | 0.0 | — | 0 | 0.0 | | | |
| R Parietal foramen | | | | | | | | | | |
| One | M | 11 | 7 | 63.6 | 7 | 4 | 57.1 | 23 | 16 | 69.6 |
| | F | 9 | 6 | 66.7 | 12 | 9 | 75.0 | | | |
| L Parietal foramen | | | | | | | | | | |
| One | M | 13 | 9 | 69.2 | 9 | 6 | 66.7 | 26 | 17 | 65.4 |
| | F | 10 | 6 | 60.0 | 12 | 8 | 66.7 | | | |

## TABLE 8

## CRANIAL VARIATION 4. LATERAL ASPECT

| TRAIT VARIATION | | MALE/FEMALE | | | TO-AT-1/TO-AT-2 | | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *n* | N | % | *n* | N | % | *n* | N | % |
| Marginal tuberosity | | | | | | | | | | |
| Right | M | 7 | 0 | 0.0 | 1 | 0 | 0.0 | 17 | 0 | 0.0 |
| | F | 9 | 0 | 0.0 | 11 | 0 | 0.0 | | | |
| Left | M | 5 | 0 | 0.0 | 2 | 0 | 0.0 | 13 | 0 | 0.0 |
| | F | 6 | 0 | 0.0 | 11 | 0 | 0.0 | | | |
| Pterion (discrete) | | | | | | | | | | |
| Right | M | 2 | 0 | 0.0 | 1 | 0 | 0.0 | 4 | 0 | 0.0 |
| | F | 1 | 0 | 0.0 | 3 | 0 | 0.0 | | | |
| Left | M | 4 | 0 | 0.0 | 2 | 0 | 0.0 | 8 | 0 | 0.0 |
| | F | 3 | 0 | 0.0 | 5 | 0 | 0.0 | | | |
| R Parietal notch | | | | | | | | | | |
| | M | 9 | 5 | 55.6 | 4 | 1 | 25.0 | 17 | 10 | 58.8 |
| | F | 6 | 4 | 66.7 | 11 | 7 | 63.6 | | | |
| L Parietal notch | | | | | | | | | | |
| Presence | M | 8 | 4 | 50.0 | 3 | 2 | 66.7 | 17 | 11 | 64.7 |
| | F | 8 | 6 | 75.0 | 10 | 6 | 60.0 | | | |
| Bone | M | — | 1 | 12.5 | — | 0 | 0.0 | — | 1 | 5.9 |
| | F | — | 0 | 0.0 | — | 1 | 10.0 | | | |
| Asterionic | | | | | | | | | | |
| Per skull | M | 8 | 2 | 25.0 | 4 | 1 | 25.0 | 16 | 5 | 31.3 |
| | F | 6 | 2 | 33.3 | 8 | 2 | 25.0 | | | |
| R side | M | 8 | 1 | 12.5 | 3 | 0 | 0.0 | 14 | 3 | 21.4 |
| | F | 5 | 1 | 20.0 | 8 | 2 | 25.0 | | | |
| L side | M | 7 | 2 | 28.6 | 3 | 1 | 33.3 | 14 | 4 | 28.6 |
| | F | 5 | 1 | 20.0 | 7 | 2 | 28.6 | | | |
| RL (per side) | M | 15 | 3 | 20.0 | 6 | 1 | 16.7 | 28 | 7 | 25.0 |
| | F | 10 | 2 | 20.0 | 15 | 4 | 26.7 | | | |
| Occiput form | | | | | | | | | | |
| Mound (M) | M | 14 | 3 | 21.4 | 9 | 0 | 0.0 | 26 | 4 | 15.4 |
| | F | 9 | 1 | 11.1 | 13 | 3 | 23.1 | | | |
| Ridge (R) | M | — | 3 | 21.4 | — | 1 | 11.1 | — | 6 | 23.1 |
| | F | — | 3 | 33.3 | — | 4 | 30.8 | | | |
| M-R | M | — | 0 | 0.0 | — | 2 | 22.2 | — | 3 | 11.5 |
| | F | — | 1 | 11.1 | — | 1 | 7.7 | | | |
| R-inion | M | — | 8 | 57.1 | — | 6 | 66.7 | — | 13 | 50.0 |
| | F | — | 4 | 44.4 | — | 5 | 38.5 | | | |
| Mastoid notch | | | | | | | | | | |
| Per skull | M | 12 | 4 | 33.3 | 7 | 3 | 42.9 | 28 | 9 | 32.1 |
| | F | 13 | 3 | 23.1 | 16 | 4 | 25.0 | | | |
| R side | M | 12 | 4 | 33.3 | 7 | 3 | 42.9 | 26 | 9 | 34.6 |
| | F | 11 | 3 | 27.3 | 15 | 4 | 26.7 | | | |
| L side | M | 11 | 4 | 36.4 | 6 | 2 | 33.3 | 25 | 7 | 28.0 |
| | F | 12 | 2 | 16.7 | 14 | 4 | 28.6 | | | |
| RL (per side) | M | 23 | 8 | 34.8 | 13 | 6 | 46.2 | 51 | 16 | 31.4 |
| | F | 23 | 5 | 21.7 | 29 | 8 | 27.6 | | | |
| Mastoid size | | | | | | | | | | |
| Small | M | 11 | 0 | 0.0 | 9 | 2 | 22.2 | 24 | 5 | 20.8 |
| | F | 11 | 5 | 45.5 | 14 | 3 | 21.4 | | | |
| Medium | M | — | 0 | 0.0 | — | 0 | 0.0 | — | 0 | 0.0 |
| | F | — | 0 | 0.0 | — | 0 | 0.0 | | | |
| Large | M | — | 1 | 9.1 | — | 0 | 0.0 | — | 2 | 8.3 |
| | F | — | 1 | 9.1 | — | 2 | 14.3 | | | |
| Small pendulant | M | — | 0 | 0.0 | — | 0 | 0.0 | — | 3 | 12.5 |
| | F | — | 3 | 27.3 | — | 2 | 14.3 | | | |
| Medium pendulant | M | — | 4 | 36.4 | — | 3 | 33.3 | — | 7 | 29.2 |
| | F | — | 2 | 18.2 | — | 4 | 28.6 | | | |
| Large pendulant | M | — | 6 | 54.5 | — | 4 | 44.4 | — | 7 | 29.2 |
| | F | — | 0 | 0.0 | — | 3 | 21.4 | | | |

TABLE 8—Continued

| TRAIT | VARIATION | MALE/FEMALE | | | | TO-AT-1/TO-AT-2 | | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *n* | N | % | *n* | N | % | *n* | N | % |
| Tympanic thickening | | | | | | | | | | | |
| | Per skull | M | 18 | 8 | 44.4 | 8 | 2 | 25.0 | 28 | 4 | 14.3 |
| | | F | 12 | 1 | 8.3 | 15 | 2 | 13.3 | | | |
| | R side | M | 18 | 8 | 44.4 | 8 | 2 | 25.0 | 26 | 4 | 15.4 |
| | | F | 10 | 1 | 10.0 | 14 | 2 | 14.3 | | | |
| | L side | M | 13 | 3 | 23.1 | 7 | 2 | 28.6 | 27 | 4 | 14.8 |
| | | F | 12 | 1 | 8.3 | 15 | 2 | 13.3 | | | |
| | RL (per side) | M | 31 | 11 | 35.5 | 15 | 4 | 26.7 | 53 | 8 | 15.1 |
| | | F | 22 | 2 | 9.1 | 29 | 4 | 13.8 | | | |
| Tympanic hole | | | | | | | | | | | |
| | Per skull | M | 11 | 1 | 9.1 | 6 | 0 | 0.0 | 26 | 2 | 7.7 |
| | | F | 12 | 1 | 8.3 | 14 | 2 | 14.3 | | | |
| | R side | M | 11 | 1 | 9.1 | 6 | 0 | 0.0 | 24 | 2 | 8.3 |
| | | F | 10 | 1 | 10.0 | 13 | 2 | 15.4 | | | |
| | L side | M | 11 | 1 | 9.1 | 5 | 0 | 0.0 | 25 | 1 | 4.0 |
| | | F | 12 | 0 | 0.0 | 14 | 1 | 7.1 | | | |
| | RL (per side) | M | 22 | 2 | 9.1 | 11 | 0 | 0.0 | 49 | 3 | 6.1 |
| | | F | 22 | 1 | 4.5 | 27 | 3 | 11.1 | | | |
| Tympanic exostoses | | | | | | | | | | | |
| | Per skull | M | 11 | 5 | 45.5 | 7 | 3 | 42.9 | 27 | 11 | 40.7 |
| | | F | 13 | 4 | 30.8 | 15 | 5 | 33.3 | | | |
| | R side | M | 11 | 5 | 45.5 | 7 | 3 | 42.9 | 25 | 10 | 40.0 |
| | | F | 11 | 3 | 27.3 | 14 | 4 | 28.6 | | | |
| | L side | M | 11 | 3 | 27.3 | 6 | 2 | 33.3 | 26 | 9 | 34.6 |
| | | F | 13 | 4 | 30.8 | 15 | 4 | 26.7 | | | |
| | RL (per side) | M | 22 | 8 | 36.4 | 13 | 5 | 38.5 | 51 | 19 | 37.3 |
| | | F | 24 | 7 | 29.2 | 29 | 8 | 27.6 | | | |
| Glenoid arthritis | | | | | | | | | | | |
| | Per skull | M | 13 | 4 | 30.8 | 7 | 2 | 28.6 | 27 | 5 | 18.5 |
| | | F | 11 | 1 | 9.1 | 16 | 3 | 18.8 | | | |
| | R side | M | 13 | 4 | 30.8 | 7 | 2 | 28.6 | 25 | 5 | 20.0 |
| | | F | 9 | 1 | 11.1 | 13 | 3 | 23.1 | | | |
| | L side | M | 13 | 2 | 15.4 | 6 | 0 | 0.0 | 23 | 3 | 13.1 |
| | | F | 8 | 1 | 12.5 | 13 | 3 | 23.1 | | | |
| | RL (per side) | M | 26 | 6 | 23.1 | 13 | 2 | 15.4 | 48 | 8 | 16.7 |
| | | F | 17 | 2 | 11.8 | 28 | 6 | 21.4 | | | |

## TABLE 9

## CRANIAL VARIATION 5. MORPHOLOGY OF THE MANDIBLE

| TRAIT | VARIATION | | MALE/FEMALE | | | TO-AT-1/TO-AT-2 | | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *n* | N | % | *n* | N | % | *n* | N | % |
| Chin form | | | | | | | | | | | |
| | Median (M) | M | 17 | 1 | 5.9 | 10 | 1 | 10.0 | 31 | 7 | 22.6 |
| | | F | 12 | 6 | 50.0 | 18 | 4 | 22.2 | | | |
| | Bilateral (B) | M | — | 3 | 17.7 | — | 2 | 20.0 | — | 6 | 19.4 |
| | | F | — | 1 | 8.3 | — | 4 | 22.2 | | | |
| | M-B | M | — | 3 | 17.7 | — | 0 | 0.0 | — | 4 | 12.9 |
| | | F | — | 0 | 0.0 | — | 3 | 16.7 | | | |
| | M-Angular | M | — | 2 | 11.8 | — | 1 | 10.0 | — | 4 | 12.9 |
| | | F | — | 2 | 26.7 | — | 3 | 16.7 | | | |
| | B-A | M | — | 3 | 17.7 | — | 2 | 20.0 | — | 5 | 16.1 |
| | | F | — | 2 | 16.7 | — | 4 | 22.2 | | | |
| | MBA | M | — | 5 | 29.4 | — | 4 | 40.0 | — | 5 | 16.1 |
| | | F | — | 1 | 8.3 | — | 0 | 0.0 | | | |
| Mandibular torus | | M | 18 | 0 | 0.0 | 12 | 0 | 0.0 | 35 | 2 | 5.7 |
| | | F | 12 | 1 | 8.3 | 19 | 2 | 10.5 | | | |
| Gonial eversion-inversion | | | | | | | | | | | |
| | + | M | 18 | 4 | 22.2 | 12 | 2 | 16.7 | 31 | 6 | 19.4 |
| | | F | 9 | 1 | 11.1 | 16 | 3 | 18.8 | | | |
| | ++ | M | — | 3 | 16.7 | — | 3 | 25.0 | — | 4 | 12.9 |
| | | F | — | 1 | 11.1 | — | 1 | 6.3 | | | |
| | + Inv. | M | — | 0 | 0.0 | — | 3 | 25.0 | — | 5 | 16.1 |
| | | F | — | 1 | 11.1 | — | 1 | 6.3 | | | |
| | Inv. ++ | M | — | 0 | 0.0 | — | 1 | 8.3 | — | 4 | 12.9 |
| | | F | — | 0 | 0.0 | — | 3 | 18.8 | | | |
| R Mylo-hyoid bridge | | | | | | | | | | | |
| | Arch | M | 18 | 0 | 0.0 | 12 | 0 | 0.0 | 31 | 0 | 0.0 |
| | | F | 9 | 0 | 0.0 | 14 | 0 | 0.0 | | | |
| | Distal | M | — | 2 | 11.1 | — | 1 | 8.3 | — | 2 | 6.5 |
| | | F | — | 0 | 0.0 | — | 0 | 0.0 | | | |
| | A-D | M | — | 1 | 5.6 | — | 1 | 8.3 | — | 1 | 3.2 |
| | | F | — | 0 | 0.0 | — | 0 | 0.0 | | | |
| L Mylo-hyoid bridging | | | | | | | | | | | |
| | Distal | M | 18 | 1 | 5.6 | 12 | 0 | 0.0 | 33 | 1 | 3.0 |
| | | F | 10 | 0 | 0.0 | 17 | 0 | 0.0 | | | |
| | A-D | M | — | 1 | 5.6 | — | 1 | 8.3 | — | 1 | 3.0 |
| | | F | — | 0 | 0.0 | — | 0 | 0.0 | | | |
| | Incipient bridge | M | — | 0 | 0.0 | — | 0 | 0.0 | — | 1 | 3.0 |
| | | F | — | 1 | 10.0 | — | 1 | 5.9 | | | |
| Multiple mandibular foramina | | | | | | | | | | | |
| | Per skull | M | 18 | 1 | 5.6 | 12 | 0 | 0.0 | 34 | 1 | 2.9 |
| | | F | 11 | 0 | 0.0 | 19 | 2 | 10.5 | | | |
| | R side | M | 18 | 0 | 0.0 | 12 | 0 | 0.0 | 31 | 0 | 0.0 |
| | | F | 9 | 0 | 0.0 | 17 | 0 | 0.0 | | | |
| | L side | M | 17 | 1 | 5.9 | 11 | 0 | 0.0 | 32 | 1 | 2.9 |
| | | F | 10 | 0 | 0.0 | 18 | 2 | 11.1 | | | |
| | RL (per side) | M | 35 | 1 | 2.9 | 23 | 0 | 0.0 | 63 | 1 | 1.6 |
| | | F | 19 | 0 | 0.0 | 35 | 2 | 5.7 | | | |
| Multiple mental foramina | | | | | | | | | | | |
| | Per skull | M | 18 | 3 | 16.7 | 12 | 1 | 8.3 | 35 | 6 | 17.1 |
| | | F | 12 | 2 | 16.7 | 19 | 5 | 26.3 | | | |
| | R side | M | 18 | 1 | 5.6 | 12 | 0 | 0.0 | 33 | 3 | 9.1 |
| | | F | 11 | 2 | 18.2 | 18 | 3 | 16.7 | | | |
| | L side | M | 18 | 2 | 11.1 | 12 | 1 | 8.3 | 34 | 3 | 8.8 |
| | | F | 11 | 0 | 0.0 | 18 | 2 | 11.1 | | | |
| | RL (per side) | M | 36 | 3 | 8.3 | 24 | 1 | 4.2 | 67 | 6 | 9.0 |
| | | F | 22 | 2 | 9.1 | 36 | 5 | 13.9 | | | |

TABLE 9—Continued

| TRAIT | VARIATION |  | MALE/FEMALE |  |  | TO-AT-1/TO-AT-2 |  |  | TOTAL |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | *n* | N | % | *n* | N | % | *n* | N | % |
| Condylar arthritis |  |  |  |  |  |  |  |  |  |  |  |
|  | Per skull | M | 16 | 3 | 18.8 | 11 | 0 | 0.0 | 26 | 5 | 19.2 |
|  |  | F | 7 | 2 | 28.6 | 13 | 4 | 30.8 |  |  |  |
|  | R side | M | 12 | 3 | 25.0 | 9 | 0 | 0.0 | 20 | 4 | 20.0 |
|  |  | F | 6 | 1 | 16.7 | 9 | 2 | 22.2 |  |  |  |
|  | L side | M | 12 | 0 | 0.0 | 9 | 0 | 0.0 | 21 | 2 | 9.5 |
|  |  | F | 6 | 2 | 33.3 | 10 | 2 | 20.0 |  |  |  |
|  | RL (per side) | M | 24 | 3 | 12.5 | 18 | 0 | 0.0 | 41 | 6 | 14.6 |
|  |  | F | 12 | 3 | 25.0 | 19 | 4 | 21.1 |  |  |  |
| Rocker jaw |  |  |  |  |  |  |  |  |  |  |  |
|  | Full | M | 18 | 10 | 55.6 | 11 | 7 | 63.6 | 34 | 23 | 67.6 |
|  |  | F | 12 | 7 | 58.3 | 19 | 13 | 68.4 |  |  |  |
|  | Slight | M | — | 1 | 5.6 | — | 0 | 0.0 | — | 3 | 8.8 |
|  |  | F | — | 0 | 0.0 | — | 3 | 15.8 |  |  |  |
| Coronoid: condyle (Hd.) relationship |  |  |  |  |  |  |  |  |  |  |  |
|  | C = Hd. | M | 12 | 5 | 41.7 | 4 | 2 | 50.0 | 23 | 13 | 56.5 |
|  |  | F | 14 | 8 | 57.1 | 14 | 1 | 7.1 |  |  |  |
|  | C > Hd. + | M | — | 6 | 50.0 | — | 1 | 25.0 | — | 7 | 30.4 |
|  |  | F | — | 4 | 28.6 | — | 4 | 28.6 |  |  |  |
|  | C > Hd. ++ | M | — | 1 | 8.3 | — | 0 | 0.0 | — | 1 | 4.3 |
|  |  | F | — | 1 | 7.1 | — | 1 | 7.1 |  |  |  |
| Coronoid < condyle |  | M | — | 0 | 0.0 | — | 0 | 0.0 | — | 2 | 8.7 |
|  |  | F | — | 1 | 7.1 | — | 1 | 7.1 |  |  |  |

## TABLE 10

## CRANIAL VARIATION OF SUBADULT INDIVIDUALS

| TRAIT | VARIATION | *n* | N | % |
|---|---|---|---|---|
| Metopic suture | Trace | 6 | 1 | 16.7 |
| | Persist. on brow | — | 4 | 66.7 |
| Frontal grooves | Per skull | 2 | 0 | 0.0 |
| R supraorbital | Single for. | 4 | 4 | 100.0 |
| L supraorbital | Spurred notch | 2 | 2 | 100.0 |
| R infraorbital | Single | 3 | 3 | 100.0 |
| L infraorbital | Single | 5 | 5 | 100.0 |
| Os Japonicum | | 2 | 0 | 0.0 |
| R malar tuberosity | + | 2 | 1 | 50.0 |
| L malar tuberosity | + | 1 | 1 | 100.0 |
| R zygomaxillary tuberosity | + | 8 | 6 | 75.0 |
| | ++ | — | 1 | 12.5 |
| L zygomaxillary tuberosity | + | 7 | 6 | 85.7 |
| | ++ | — | 1 | 14.3 |
| Palatine torus | | 4 | 0 | 0.0 |
| R ovale-spinosum | Normal | 5 | 4 | 80.0 |
| | Other | — | 1 | 20.0 |
| L ovale-spinosum | Normal | 7 | 6 | 85.7 |
| | Other | — | 1 | 14.3 |
| Precondylar tubercle | | 1 | 0 | 0.0 |
| Ossified apical | | 1 | 0 | 0.0 |
| Paramastoid | R+L— | 1 | 1 | 100.0 |
| Anterior condylar canal—doubling | Per skull | 5 | 0 | 0.0 |
| Posterior condylar canal | Per skull | 2 | 1 | 50.0 |
| Occipital condyles | R1L1 | 1 | 1 | 100.0 |
| Lateral sinus | Right | 6 | 4 | 66.7 |
| | Left | — | 2 | 33.3 |
| Coronal wormians | | 2 | 0 | 0.0 |
| Sagittal wormians | | 1 | 0 | 0.0 |
| Bregmatic bone | | 2 | 0 | 0.0 |
| Lambdoid wormians | | 1 | 0 | 0.0 |
| At Lambda | | 1 | 0 | 0.0 |
| Sagittal keel | + | 1 | 1 | 100.0 |
| Parietal bossing | + | 3 | 1 | 33.3 |
| | ++ | — | 1 | 33.3 |
| R parietal foramen | Single | 3 | 1 | 33.3 |
| L parietal foramen | Single | 3 | 1 | 33.3 |
| R marginal tuberosity | | 2 | 0 | 0.0 |
| L marginal tuberosity | | 2 | 0 | 0.0 |
| R pterion | H | 1 | 1 | 100.0 |
| L pterion | H | 1 | 1 | 100.0 |
| R parietal notch | | 1 | 0 | 0.0 |
| L parietal notch | | 1 | 0 | 0.0 |
| Asterionic | | 1 | 0 | 0.0 |
| Occiput form | Ridge | 2 | 1 | 50.0 |
| | R-inion | — | 1 | 50.0 |
| Mastoid notch | Per skull | 3 | 0 | 0.0 |
| Tympanic thickening | | 4 | 0 | 0.0 |
| Tympanic dehiscence | | 4 | 0 | 0.0 |
| Tympanic exostoses | Per skull | 8 | 2 | 25.0 |
| Chin form | Median | 6 | 3 | 50.0 |
| | Bilateral | — | 3 | 50.0 |
| Mandibular torus | | 11 | 0 | 0.0 |
| Gonial eversion | + | 4 | 1 | 25.0 |
| | Inv. + | — | 1 | 25.0 |
| R mylo-hyoid bridge | | 10 | 0 | 0.0 |
| L mylo-hyoid bridge | | 11 | 0 | 0.0 |
| Multiple mandibular foramina | Per skull | 13 | 2 | 15.4 |
| Multiple mental foramina | Per skull | 18 | 3 | 16.7 |
| | R side | — | 3 | 16.7 |
| | L side | — | 1 | |
| | RL (per side) | — | 4 | 22.2 |
| Rocker jaw | Full | 6 | 4 | 66.7 |
| | Slight | — | 1 | 16.7 |

TABLE 11

SELECTED GROUPED ADULT AND SUBADULT CRANIAL VARIATIONS

| TRAIT | VARIATION | *n* | N | % |
|---|---|---|---|---|
| Metopic suture | | | | |
| | Brow only | 29 | 19 | 65.5 |
| Frontal grooves | | | | |
| | Per skull | 26 | 1 | 3.8 |
| R supraorbital | | | | |
| | Foramen | 30 | 12 | 40.0 |
| | Notch | — | 3 | 10.0 |
| | Spurred notch | — | 15 | 50.0 |
| L supraorbital | | | | |
| | Foramen | 22 | 5 | 22.7 |
| | Notch | — | 2 | 9.1 |
| | Spurred notch | — | 12 | 54.5 |
| | Double for. | — | 1 | 4.5 |
| R infraorbital | | | | |
| | Single | 10 | 3 | 30.0 |
| | Two separate | — | 6 | 60.0 |
| | Two divided | — | 1 | 10.0 |
| L infraorbital | | | | |
| | Single | 12 | 5 | 41.7 |
| | Two separate | — | 6 | 50.0 |
| | Two divided | — | 1 | 8.3 |
| Os Japonicum | | 17 | 0 | 0.0 |
| R malar tuberosity | | | | |
| | + | 18 | 3 | 16.7 |
| | ++ | — | 0 | 0.0 |
| | +++ | — | 0 | 0.0 |
| L malar tuberosity | | | | |
| | + | 14 | 3 | 21.4 |
| | ++ | — | 0 | 0.0 |
| | +++ | — | 0 | 0.0 |
| R zygomaxillary tuberosity | | | | |
| | + | 24 | 11 | 45.8 |
| | ++ | — | 2 | 8.3 |
| | +++ | — | 0 | 0.0 |
| L zygomaxillary tuberosity | | | | |
| | + | 19 | 11 | 57.9 |
| | ++ | — | 2 | 10.5 |
| | +++ | — | 0 | 0.0 |
| Palatine torus | | 22 | 1 | 4.5 |
| Anterior condylar canal doubled | | | | |
| | Per skull | 26 | 4 | 15.4 |
| Posterior condylar canal | | 18 | 10 | 55.6 |
| Occipital condyles | | | | |
| | R1L1 | 21 | 13 | 61.9 |
| | R2L2 | — | 1 | 4.8 |
| | R1L2 | — | 1 | 4.8 |
| | R1 | — | 2 | 9.5 |
| | R2 | — | 2 | 9.5 |
| | L1 | — | 0 | 0.0 |
| | L2 | — | 2 | 9.5 |

| TRAIT | VARIATION | *n* | N | % |
|---|---|---|---|---|
| Lateral sinus | | | | |
| | Right | 29 | 23 | 79.3 |
| | Left | — | 3 | 10.3 |
| | Common | — | 3 | 10.3 |
| Coronal wormians | | 24 | 0 | 0.0 |
| Sagittal wormians | | 22 | 0 | 0.0 |
| Bregmatic bone | | 23 | 0 | 0.0 |
| Lambdoid wormian | | | | |
| | One | 24 | 1 | 4.2 |
| | Two | — | 0 | 0.0 |
| | Three | — | 3 | 12.5 |
| | 3+ | — | 5 | 20.8 |
| At Lambda | | | | |
| | Os Inca | 24 | 1 | 4.2 |
| | Trace | — | 1 | 4.2 |
| | Lambdic bone | — | 0 | 0.0 |
| | Bulge | — | 2 | 8.3 |
| R parietal foramen | | | | |
| | Single | 26 | 17 | 65.4 |
| L parietal foramen | | 29 | 20 | 69.0 |
| R parietal notch | | 18 | 10 | 55.6 |
| L parietal notch | | | | |
| | Notch | 18 | 11 | 61.1 |
| | Bone | — | 1 | 5.6 |
| Asterionic | | 17 | 5 | 29.4 |
| Mastoid notch | | 31 | 9 | 29.0 |
| Auditory exostoses | | 29 | 13 | 44.8 |
| Mandibular torus | | 46 | 2 | 4.3 |
| R mylo-hyoid bridge | | | | |
| | Distal | 41 | 2 | 4.9 |
| | A-D | — | 1 | 2.4 |
| L mylo-hyoid bridge | | | | |
| | Distal | 41 | 1 | 2.3 |
| | A-D | — | 1 | 2.3 |
| | Incipient bridge | — | 1 | 2.3 |
| Multiple mandibular foramina | | | | |
| | Per skull | 47 | 3 | 6.4 |
| Multiple mental foramina | | | | |
| | Per skull | 53 | 9 | 17.0 |
| Rocker jaw | | | | |
| | Full | 40 | 27 | 67.5 |
| | Slight | — | 4 | 10.0 |
| Paramastoid | | | | |
| | Per skull | 12 | 6 | 50.0 |
| | R side | 6 | 5 | 83.3 |
| | L side | 7 | 4 | 57.1 |
| | RL (per side) | 13 | 9 | 69.2 |

## TABLE 12

## CRANIOMETRY

| | MALE | | | | FEMALE | | | |
|---|---|---|---|---|---|---|---|---|
| Measurement | *n* | Range | Mean | S.D. | *n* | Range | Mean | S.D. |
| Cranial length | 13 | 174 - 196 | 183.1 | 7.9 | 5 | 170 - 181 | 172.6 | 4.2 |
| Cranial breadth | 12 | 130 - 170 | 143.0 | 10.0 | 4 | 123 - 143 | 133.5 | 7.4 |
| Cranial height | 6 | 140 - 155 | 144.8 | 5.2 | 2 | 138 - 144 | 141.0 | 3.0 |
| Cranial capacity | 6 | 1371.8-1710.5 | 1514.2 | 119.7 | 2 | 1262.2-1361.3 | 1311.7 | 49.6 |
| Cranial module | 6 | 148.3- 165.7 | 157.1 | 5.8 | 2 | 143.7- 152.7 | 148.2 | 4.5 |
| Cranial index | 11 | 72.4- 91.4 | 78.3 | 6.2 | 4 | 72.4- 83.6 | 77.1 | 4.1 |
| Length-height index | 6 | 75.8- 84.5 | 80.4 | 2.7 | 2 | 81.2- 84.2 | 82.7 | 1.5 |
| Breadth-height index | 6 | 82.9- 110.7 | 99.8 | 9.1 | 2 | 100.7- 112.2 | 106.4 | 5.8 |
| Basion-nasion | 5 | 106 - 111 | 108.6 | 1.7 | 2 | 101 - 110 | 105.5 | 4.5 |
| Basion-prosthion | 3 | 99 - 108 | 103.7 | 3.7 | 0 | —— | — | — |
| Gnathic index | 3 | 93.4- 98.2 | 96.0 | 2.0 | 0 | —— | — | — |
| Min. frontal breadth | 12 | 89 - 112 | 101.8 | 6.4 | 5 | 90 - 103 | 97.6 | 4.8 |
| Bizygomatic diam. | 3 | 140 - 145 | 142.7 | 2.1 | 0 | —— | — | — |
| Upper facial height | 3 | 65 - 75 | 68.7 | 4.5 | 0 | —— | — | — |
| Upper facial index | 3 | 45.5- 51.7 | 48.1 | 2.6 | 0 | —— | — | — |
| Total facial height | 2 | 113 - 120 | 116.5 | 3.5 | 0 | —— | — | — |
| Total facial index | 2 | 79.0- 85.7 | 82.4 | 3.3 | 0 | —— | — | — |
| Orbital breadth | 3 | 45 - 47 | 46.0 | 0.8 | 0 | —— | — | — |
| Orbital height | 3 | 32 - 39 | 35.7 | 2.9 | 0 | —— | — | — |
| Orbital index | 3 | 69.6- 83.0 | 77.5 | 5.8 | 0 | —— | — | — |
| Nasal breadth | 3 | 28 - 29 | 28.3 | 0.5 | 0 | —— | — | — |
| Nasal height | 3 | 51 - 62 | 55.3 | 4.8 | 0 | —— | — | — |
| Nasal index | 3 | 45.2- 56.9 | 51.6 | 4.9 | 0 | —— | — | — |
| Alveolar breadth | 5 | 62 - 68 | 64.8 | 2.7 | 2 | 55 - 66 | 60.5 | 5.5 |
| Alveolar height | 4 | 42 - 63 | 58.3 | 4.0 | 1 | 55 | 55 | 0.0 |
| Alveolar index | 4 | 105.0- 128.3 | 113.0 | 9.1 | 1 | 120.0 | 120.0 | 0.0 |
| Bigonial diameter | 17 | 88 - 115 | 101.3 | 8.5 | 7 | 92 - 101 | 95.3 | 2.9 |
| Symphysis height | 18 | 24 - 35 | 30.3 | 3.1 | 10 | 26 - 34 | 29.5 | 2.3 |
| Ramus height | 18 | 51 - 75 | 61.3 | 7.1 | 9 | 45 - 68* | 59.7 | 7.0 |
| Ramus breadth | 18 | 30 - 46 | 37.6 | 3.8 | 10 | 33 - 42 | 36.2 | 2.9 |
| Mandibular length | 14 | 101 - 116 | 109.1 | 4.7 | 7 | 90 - 118 | 106.4 | 8.5 |
| Bicondylar width | 14 | 114 - 138 | 126.4 | 7.7 | 4 | 109 - 132 | 121.0 | 8.2 |

* An approximate value having the same meaning throughout this report when used in association with metrical values.

## TABLE 13

## FREQUENCY OF OCCURRENCE OF MANDIBULAR MOLAR FISSURE PATTERNS ACCORDING TO SEX

| Fissure pattern | | **M1** | | | | | | | **M2** | | | | | | | **M3** | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | R | | | L | | | | R | | | L | | | | R | | | L | | | |
| | | M. | F. | ? | M. | F | ? | Grand Total | M. | F. | ? | M. | F | ? | Grand Total | M. | F. | ? | M. | F | ? | Grand Total |
| | *n* | 7 | 5 | 4 | 9 | 5 | 4 | 34 | 9 | 6 | 6 | 11 | 6 | 5 | 43 | 8 | 6 | 4 | 7 | 6 | 3 | 34 |
| +4 | N. | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 6 | 4 | 5 | 8 | 5 | 3 | 31 | 1 | 3 | 0 | 0 | 0 | 0 | 4 |
| | % | — | 20.0 | — | — | — | — | 2.9 | 66.7 | 66.7 | 83.3 | 72.7 | 83.3 | 60.0 | 72.1 | 12.5 | 50.0 | — | — | — | — | 11.8 |
| +5 | N. | 7 | 4 | 2 | 4 | 2 | 3 | 22 | 3 | 1 | 0 | 3 | 0 | 2 | 9 | 3 | 1 | 1 | 6 | 5 | 2 | 18 |
| | % | 100.0 | 80.0 | 50.0 | 44.4 | 40.0 | 75.0 | 64.7 | 33.3 | 16.7 | | 27.3 | | 40.0 | 20.9 | 37.5 | 16.7 | 25.0 | 85.7 | 83.3 | 66.7 | 52.9 |
| Y5 | N. | 0 | 0 | 0 | 5 | 3 | 1 | 9 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| | % | — | — | — | 55.6 | 60.0 | 25.0 | 26.5 | — | — | 16.7 | — | — | — | 2.3 | 12.5 | — | — | — | — | — | 2.9 |
| Y4 | N. | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| | % | — | — | 25.0 | — | — | — | 2.9 | — | 16.7 | — | — | — | — | 2.3 | 12.5 | — | — | — | — | — | 2.9 |
| Crenulated +5 | N. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 3 |
| | % | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 16.7 | 25.0 | — | — | 33.3 | 8.8 |
| Wrinkled | N. | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 1 | 2 | 1 | 1 | 0 | 7 |
| | % | — | — | 25.0 | — | — | — | 2.9 | — | — | — | — | 16.7 | — | 2.3 | 25.0 | 16.7 | 50.0 | 14.3 | 16.7 | — | 20.6 |

## TABLE 14

### FREQUENCY OF OCCURRENCE OF SHOVEL-SHAPED INCISORS (MAXILLARY)

| DEGREE | | CENTRAL INCISOR | | | | | | | | | LATERAL INCISOR | | | | | | | | | GRAND TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | R | | | L | | | T | | | R | | | L | | | T | | | |
| | | M. | F. | ? | M. | F. | ? | M. | F. | ? | M. | F. | ? | M. | F. | ? | M. | F. | ? | |
| | *n* | 5 | 5 | 4 | 6 | 3 | 3 | 11 | 8 | 7 | 8 | 5 | 8 | 10 | 5 | 5 | 18 | 10 | 13 | 87 |
| No shovel | N. | 4 | 2 | 3 | 5 | 0 | 2 | 9 | 2 | 5 | 6 | 3 | 7 | 8 | 2 | 3 | 14 | 5 | 10 | 45 |
| | % | 80.0 | 40.0 | 75.0 | 83.3 | — | 66.7 | 81.8 | 25.0 | 71.4 | 75.0 | 60.0 | 87.5 | 80.0 | 40.0 | 60.0 | 77.8 | 50.0 | 76.9 | 51.7 |
| Slight shovel | N. | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 2 | 1 | 1 | 0 | 0 | 1 | 2 | 1 | 2 | 2 | 1 | 8 |
| | % | — | 20.0 | — | — | 33.3 | 33.3 | — | 25.0 | 14.3 | 12.5 | — | — | 10.0 | 40.0 | 20.0 | 11.1 | 20.0 | 7.7 | 9.2 |
| Shovel | N. | 1 | 2 | 1 | 1 | 2 | 0 | 2 | 4 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 3 | 2 | 14 |
| | % | 20.0 | 40.0 | 25.0 | 16.7 | 66.7 | — | 18.2 | 50.0 | 14.3 | 12.5 | 40.0 | 12.5 | 10.0 | 20.0 | 20.0 | 11.1 | 30.0 | 15.4 | 16.1 |
| All kinds of shovelling | N. | 1 | 3 | 1 | 1 | 3 | 1 | 2 | 6 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 4 | 5 | 3 | 22 |
| | % | 20.0 | 60.0 | 25.0 | 16.7 | 100.0 | 33.3 | 18.2 | 75.0 | 28.6 | 25.0 | 40.0 | 12.5 | 20.0 | 60.0 | 40.0 | 22.2 | 50.0 | 23.1 | 25.3 |

## TABLE 15

## THE INCIDENCE OF PREMORTEM AND POSTMORTEM TOOTH LOSS

| TOOTH GROUP | *n* | NUMBER<br>POSTMORTEM | <br>PREMORTEM | INCIDENCE<br>POSTMORTEM<br>% | <br>PREMORTEM<br>% |
|---|---|---|---|---|---|
| Upper molar | 174 | 16 | 13 | 9.2 | 7.5 |
| Lower molar | 221 | 16 | 46 | 7.2 | 20.8 |
| Total | 395 | 32 | 59 | 8.1 | 14.9 |
| Upper premolar | 124 | 17 | 8 | 13.7 | 6.5 |
| Lower premolar | 152 | 25 | 5 | 16.4 | 3.3 |
| Total | 276 | 42 | 13 | 15.2 | 4.7 |
| Upper canine | 63 | 19 | 4 | 30.2 | 6.3 |
| Lower canine | 73 | 18 | 4 | 24.7 | 5.5 |
| Total | 136 | 37 | 8 | 27.2 | 5.9 |
| Upper incisor | 124 | 50 | 6 | 40.3 | 4.8 |
| Lower incisor | 150 | 59 | 8 | 39.3 | 5.3 |
| Total | 274 | 109 | 14 | 39.8 | 5.1 |
| Upper total | 485 | 102 | 31 | 21.0 | 6.4 |
| Lower total | 596 | 118 | 63 | 19.8 | 10.6 |
| Grand total | 1081 | 220 | 94 | 20.4 | 8.7 |

## TABLE 16

## FREQUENCY OF OCCURRENCE OF ATTRITION OF MAXILLARY DENTITIONS

| TOOTH GROUP | DEGREE | NUMBER<br>M | <br>F | <br>? | <br>T | PERCENTAGE<br>M | <br>F | <br>? | <br>TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| Ant. maxillary region | *n* | 12 | 7 | 7 | — | — | — | — | 26 |
| | None | 2 | 1 | 1 | 4 | 16.7 | 14.3 | 14.3 | 15.4 |
| | Slight | 5 | 3 | 5 | 13 | 41.7 | 42.8 | 71.4 | 50.0 |
| | Blunting | 5 | 2 | 1 | 8 | 41.7 | 28.6 | 14.3 | 30.8 |
| | Dentine exposed | 0 | 1 | 0 | 1 | 0.0 | 14.3 | 0.0 | 3.8 |
| | Pulp exposed | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Post. maxillary region | *n* | 11 | 7 | 8 | — | — | — | — | 26 |
| | None | 2 | 1 | 1 | 4 | 18.2 | 14.3 | 12.5 | 15.4 |
| | Slight | 4 | 3 | 5 | 12 | 36.4 | 42.8 | 62.5 | 46.2 |
| | Blunting | 5 | 2 | 1 | 8 | 45.5 | 28.6 | 12.5 | 30.8 |
| | Dentine exposed | 0 | 1 | 1 | 2 | 0.0 | 14.3 | 12.5 | 7.7 |
| | Pulp exposed | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| General maxillary attrition | *n* | 14 | 7 | 9 | — | — | — | — | 30 |
| | None | 2 | 1 | 1 | 4 | 14.3 | 14.3 | 11.1 | 13.3 |
| | Slight | 6 | 3 | 2 | 11 | 42.9 | 42.8 | 22.2 | 36.7 |
| | Medium | 5 | 2 | 4 | 11 | 35.7 | 28.6 | 44.4 | 36.7 |
| | Marked | 1 | 1 | 2 | 4 | 7.1 | 14.3 | 22.2 | 13.3 |

## TABLE 17

## FREQUENCY OF OCCURRENCE OF ATTRITION OF MANDIBULAR DENTITIONS

| TOOTH GROUP | DEGREE | | NUMBER | | | | PERCENTAGE | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | M | F | ? | T | M | F | ? | TOTAL |
| Ant. mandibular | teeth | *n* | 14 | 12 | 9 | — | — | — | — | 35 |
| | None | | 1 | 1 | 1 | 3 | 7.1 | 8.3 | 11.1 | 8.6 |
| | Slight | | 8 | 7 | 3 | 18 | 57.1 | 58.3 | 33.3 | 51.4 |
| | Blunting | | 3 | 1 | 5 | 9 | 21.4 | 8.3 | 55.6 | 25.7 |
| | Dentine exposed | | 2 | 3 | 0 | 5 | 14.3 | 25.0 | 0.0 | 14.3 |
| | Pulp exposed | | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Post. mandibular | teeth | *n* | 14 | 12 | 8 | — | — | — | — | 34 |
| | None | | 1 | 1 | 1 | 3 | 7.1 | 8.3 | 12.5 | 8.8 |
| | Slight | | 7 | 4 | 2 | 13 | 50.0 | 33.3 | 25.0 | 38.2 |
| | Blunting | | 4 | 1 | 5 | 10 | 28.5 | 8.3 | 62.5 | 29.4 |
| | Dentine exposed | | 1 | 5 | 0 | 6 | 7.1 | 41.7 | 0.0 | 17.6 |
| | Pulp exposed | | 1 | 1 | 0 | 2 | 7.1 | 8.3 | 0.0 | 5.9 |
| General mandibular attrition | | *n* | 18 | 11 | 10 | — | — | — | — | 39 |
| | None | | 1 | 1 | 2 | 4 | 5.5 | 9.1 | 20.0 | 10.3 |
| | Slight | | 7 | 3 | 2 | 12 | 38.2 | 27.3 | 20.0 | 30.8 |
| | Medium | | 6 | 3 | 5 | 14 | 33.3 | 27.3 | 50.0 | 35.9 |
| | Marked | | 4 | 4 | 1 | 9 | 22.2 | 36.4 | 10.0 | 23.1 |

## TABLE 18

## INCIDENCE OF VARIOUS TYPES OF CARIES FOUND IN THE TOTAL ADULT SERIES

| TOOTH GROUP (*n*) | | BUCCAL NECK | LINGUAL NECK | INTERPROXIMAL NECK | DEEP OCCLUSAL | PIT | TOTAL |
|---|---|---|---|---|---|---|---|
| Upper molars | N | 6 | 0 | 8 | 0 | 8 | 22 |
| (165) | % | 3.6 | — | 4.8 | 0 | 4.8 | 13.3 |
| Upper premolars | N | 1 | 0 | 0 | 1 | 1 | 3 |
| (120) | % | 0.8 | — | — | 0.8 | 0.8 | 2.5 |
| Upper canine | N | 1 | 0 | 2 | 2 | 1 | 6 |
| ( 58) | % | 1.7 | — | 3.4 | 3.4 | 1.7 | 10.3 |
| Upper incisor | N | 3 | 0 | 3 | 0 | 2 | 8 |
| (101) | % | 3.0 | — | 3.0 | — | 2.0 | 7.9 |
| Total upper | N | 11 | 0 | 13 | 3 | 12 | 39 |
| (444) | % | 2.5 | — | 2.9 | 0.7 | 2.7 | 8.8 |
| Lower molars | N | 8 | 2 | 5 | 1 | 13 | 29 |
| (222) | % | 3.6 | 0.9 | 2.3 | 0.5 | 5.9 | 13.1 |
| Lower premolars | N | 6 | 0 | 4 | 1 | 1 | 12 |
| (151) | % | 4.0 | — | 2.6 | 0.7 | 0.7 | 7.9 |
| Lower canine | N | 2 | 0 | 2 | 0 | 0 | 4 |
| ( 73) | % | 2.7 | — | 2.7 | — | — | 5.5 |
| Lower incisor | N | 0 | 0 | 2 | 0 | 0 | 2 |
| (142) | % | — | — | 1.4 | — | — | 1.4 |
| Total lower | N | 16 | 2 | 13 | 2 | 14 | 47 |
| (588) | % | 2.7 | 0.3 | 2.2 | 0.3 | 2.4 | 8.0 |
| Grand total | N | 27 | 2 | 26 | 5 | 26 | 86 |
| (1032) | % | 2.6 | 0.2 | 2.5 | 0.5 | 2.5 | 8.3 |

TABLE 19

THE INCIDENCE OF CARIES FOR THE TOTAL SERIES

| TOOTH GROUP | *n* | NUMBER | PERCENTAGE |
|---|---|---|---|
| All molars | 387 | 51 | 13.2 |
| All premolars | 271 | 15 | 5.5 |
| All canines | 131 | 10 | 7.6 |
| All incisors | 243 | 10 | 4.1 |
| Total | 1032 | 86 | 8.3 |

TABLE 20

FREQUENCY OF OCCURRENCE OF PERIODONTAL DISEASE

| REGION | DEGREE | | NUMBER | | | | PERCENTAGE | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | M | F | ? | TOTAL | M | F | ? | TOTAL |
| Maxillary dentition | | | | | | | | | | |
| Calculus build-up | | *n* | 14 | 5 | 9 | — | — | — | — | 28 |
| | 0 | | 4 | 1 | 0 | 5 | 28.6 | 20.0 | 0.0 | 17.9 |
| | + | | 5 | 0 | 5 | 10 | 35.7 | 0.0 | 55.6 | 35.7 |
| | ++ | | 2 | 2 | 4 | 8 | 14.3 | 40.0 | 44.4 | 28.6 |
| | +++ | | 3 | 2 | 0 | 5 | 21.4 | 40.0 | 0.0 | 17.9 |
| Alveolar recession | | *n* | 13 | 6 | 10 | — | — | — | — | 29 |
| | 0 | | 2 | 1 | 2 | 5 | 15.4 | 16.7 | 20.0 | 17.2 |
| | + | | 2 | 0 | 1 | 3 | 15.4 | 0.0 | 10.0 | 10.3 |
| | ++ | | 4 | 3 | 7 | 14 | 30.8 | 50.0 | 70.0 | 48.3 |
| | +++ | | 5 | 2 | 0 | 7 | 38.5 | 33.3 | 0.0 | 24.1 |
| Rolled rim | | *n* | 7 | 3 | 6 | — | — | — | — | 16 |
| | 0 | | 5 | 1 | 3 | 9 | 71.4 | 33.3 | 50.0 | 56.2 |
| | + | | 1 | 1 | 1 | 3 | 14.3 | 33.3 | 16.7 | 18.8 |
| | ++ | | 0 | 1 | 1 | 2 | 0.0 | 33.3 | 16.7 | 12.5 |
| | +++ | | 1 | 0 | 1 | 2 | 14.3 | 0.0 | 16.7 | 12.5 |
| Mandibular dentition | | | | | | | | | | |
| Calculus build-up | | *n* | 17 | 12 | 10 | — | — | — | — | 39 |
| | 0 | | 5 | 2 | 3 | 10 | 29.4 | 16.7 | 30.0 | 25.6 |
| | + | | 5 | 5 | 4 | 14 | 29.4 | 41.7 | 40.0 | 35.9 |
| | ++ | | 6 | 4 | 2 | 12 | 35.3 | 33.3 | 20.0 | 30.8 |
| | +++ | | 1 | 1 | 1 | 3 | 5.9 | 8.3 | 10.0 | 7.7 |
| Alveolar recession | | *n* | 17 | 12 | 9 | — | — | — | — | 38 |
| | 0 | | 2 | 3 | 1 | 6 | 11.8 | 25.0 | 11.1 | 15.8 |
| | + | | 5 | 1 | 2 | 8 | 29.4 | 8.3 | 22.2 | 21.1 |
| | ++ | | 6 | 5 | 6 | 17 | 35.3 | 41.7 | 66.7 | 44.7 |
| | +++ | | 4 | 3 | 0 | 7 | 23.5 | 25.0 | 0.0 | 18.4 |
| Rolled rim | | *n* | 11 | 10 | 8 | — | — | — | — | 29 |
| | 0 | | 5 | 2 | 4 | 11 | 45.5 | 20.0 | 50.0 | 37.9 |
| | + | | 6 | 4 | 1 | 11 | 54.5 | 40.0 | 12.5 | 37.9 |
| | ++ | | 0 | 4 | 3 | 7 | 0.0 | 40.0 | 37.5 | 24.1 |
| | +++ | | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |

TABLE 21

MORPHOLOGICAL VARIATION OF THE CERVICAL VERTEBRAE

| AREA | VARIATION | SEX | RIGHT | | LEFT | | RIGHT | LEFT | TOTAL (RL) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *n* | N | *n* | N | % | % | *n* | N | % |
| C-1 | | | | | | | | | | | |
| | Superior articular facet | | | | | | | | | | |
| | Single | M | 11 | 9 | 13 | 10 | 81.9 | 76.9 | 24 | 19 | 79.2 |
| | | F | 9 | 8 | 8 | 7 | 88.9 | 87.5 | 17 | 15 | 88.2 |
| | Double | M | — | 1 | — | 1 | 9.1 | 7.7 | — | 2 | 8.3 |
| | | F | — | 0 | — | 0 | 0.0 | 0.0 | — | 0 | 0.0 |
| | Constricted | M | — | 1 | — | 2 | 9.1 | 15.4 | — | 3 | 12.5 |
| | | F | — | 1 | — | 1 | 11.1 | 12.5 | — | 2 | 11.7 |
| | Foramen transversarium | | | | | | | | | | |
| | Single | M | 11 | 11 | 13 | 13 | 100.0 | 100.0 | 24 | 24 | 100.0 |
| | | F | 8 | 8 | 8 | 8 | 100.0 | 100.0 | 16 | 16 | 100.0 |
| | R:L foramen transversarium | | | | | | | | | | |
| | R > L | M | | | | | | | 8 | 2 | 25.0 |
| | | F | | | | | | | 4 | 3 | 75.0 |
| | R < L | M | | | | | | | — | 2 | 25.0 |
| | | F | | | | | | | — | 0 | 0.0 |
| | R = L | M | | | | | | | — | 4 | 50.0 |
| | | F | | | | | | | — | 1 | 25.0 |
| | Bridging, presence | M | 11 | 0 | 13 | 0 | 0.0 | 0.0 | 24 | 0 | 0.0 |
| | | F | 8 | 0 | 8 | 0 | 0.0 | 0.0 | 16 | 0 | 0.0 |
| | Posterior arch foramen | | | | | | | | | | |
| | Presence | M | 11 | 1 | 12 | 0 | 9.1 | 0.0 | 23 | 1 | 4.3 |
| | | F | 8 | 1 | 8 | 1 | 12.5 | 12.5 | 16 | 2 | 12.5 |
| C-2 | | | | | | | | | | | |
| | Ossified apical ligament | | | | | | | | | | |
| | Presence | M | | | | | | | 15 | 1 | 6.7 |
| | | F | | | | | | | 8 | 1 | 12.5 |
| | Superior articular facet | | | | | | | | | | |
| | Single | M | 15 | 15 | 15 | 15 | 100.0 | 100.0 | 30 | 30 | 100.0 |
| | | F | 5 | 5 | 6 | 6 | 100.0 | 100.0 | 11 | 11 | 100.0 |
| | Foramen transversarium | | | | | | | | | | |
| | Single | M | 15 | 15 | 15 | 15 | 100.0 | 100.0 | 30 | 30 | 100.0 |
| | | F | 5 | 5 | 6 | 6 | 100.0 | 100.0 | 11 | 11 | 100.0 |
| | R:L foramen transversarium | | | | | | | | | | |
| | R = L | M | | | | | | | 13 | 8 | 61.5 |
| | | F | | | | | | | 3 | 2 | 66.7 |
| | R > L | M | | | | | | | — | 3 | 23.1 |
| | | F | | | | | | | — | 0 | 0.0 |
| | R < L | M | | | | | | | — | 2 | 15.4 |
| | | F | | | | | | | — | 1 | 33.3 |
| C-3 | | | | | | | | | | | |
| | Foramen transversarium | | | | | | | | | | |
| | Single | M | 12 | 12 | 11 | 11 | 100.0 | 100.0 | 23 | 23 | 100.0 |
| | | F | 6 | 6 | 5 | 5 | 100.0 | 100.0 | 11 | 11 | 100.0 |
| | R:L foramen transversarium | | | | | | | | | | |
| | R = L | M | | | | | | | 6 | 4 | 66.7 |
| | | F | | | | | | | 4 | 3 | 75.0 |
| | R > L | M | | | | | | | — | 1 | 16.7 |
| | | F | | | | | | | — | 0 | 0.0 |
| | R < L | M | | | | | | | — | 1 | 16.7 |
| | | F | | | | | | | — | 1 | 25.0 |
| | Superior articular surface | | | | | | | | | | |
| | Single | M | 13 | 13 | 12 | 12 | 100.0 | 100.0 | 25 | 25 | 100.0 |
| | | F | 7 | 7 | 6 | 6 | 100.0 | 100.0 | 13 | 13 | 100.0 |
| C-4 | | | | | | | | | | | |
| | Foramen transversarium | | | | | | | | | | |
| | Single | M | 10 | 10 | 13 | 13 | 100.0 | 100.0 | 23 | 23 | 100.0 |
| | | F | 5 | 5 | 5 | 5 | 100.0 | 100.0 | 10 | 10 | 100.0 |

TABLE 21—Continued

| AREA | VARIATION | SEX | RIGHT | | LEFT | | RIGHT | LEFT | TOTAL (RL) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *n* | N | *n* | N | % | % | *n* | N | % |
| R:L foramen transversarium | | | | | | | | | | | |
| | R = L | M | | | | | | | 6 | 3 | 50.0 |
| | | F | | | | | | | 3 | 2 | 66.7 |
| | R > L | M | | | | | | | — | 2 | 33.3 |
| | | F | | | | | | | — | 0 | 0.0 |
| | R < L | M | | | | | | | — | 1 | 16.7 |
| | | F | | | | | | | — | 1 | 33.3 |
| Superior articular surface | | | | | | | | | | | |
| | Single | M | 12 | 12 | 13 | 13 | 100.0 | 100.0 | 25 | 25 | 100.0 |
| | | F | 9 | 9 | 9 | 9 | 100.0 | 100.0 | 18 | 18 | 100.0 |
| C-5 | | | | | | | | | | | |
| Foramen transversarium | | | | | | | | | | | |
| | Single | M | 9 | 7 | 11 | 11 | 77.8 | 100.0 | 20 | 18 | 90.0 |
| | | F | 5 | 5 | 6 | 5 | 100.0 | 83.3 | 11 | 10 | 90.9 |
| | Double | M | — | 1 | — | 0 | 11.1 | 0.0 | — | 1 | 5.0 |
| | | F | — | 0 | — | 1 | 0.0 | 16.7 | — | 1 | 9.1 |
| | Single + spur | M | — | 1 | — | 0 | 11.1 | 0.0 | — | 1 | 5.0 |
| | | F | — | 0 | — | 0 | 0.0 | 0.0 | — | 0 | 0.0 |
| R:L foramen transversarium | | | | | | | | | | | |
| | R = L | M | | | | | | | 5 | 1 | 20.0 |
| | | F | | | | | | | 4 | 2 | 50.0 |
| | R > L | M | | | | | | | — | 2 | 40.0 |
| | | F | | | | | | | — | 0 | 0.0 |
| | R < L | M | | | | | | | — | 2 | 40.0 |
| | | F | | | | | | | — | 2 | 50.0 |
| Superior articular surface | | | | | | | | | | | |
| | Single | M | 10 | 10 | 11 | 11 | 100.0 | 100.0 | 21 | 21 | 100.0 |
| | | F | 8 | 8 | 7 | 7 | 100.0 | 100.0 | 15 | 15 | 100.0 |
| C-6 | | | | | | | | | | | |
| Foramen transversarium | | | | | | | | | | | |
| | Single | M | 9 | 6 | 8 | 6 | 66.7 | 75.0 | 17 | 12 | 70.6 |
| | | F | 6 | 3 | 5 | 3 | 50.0 | 60.0 | 11 | 6 | 54.5 |
| | Double | M | — | 2 | — | 2 | 22.2 | 25.0 | — | 4 | 23.5 |
| | | F | — | 3 | — | 2 | 50.0 | 40.0 | — | 5 | 45.5 |
| | Spurred | M | — | 1 | — | 0 | 11.1 | 0.0 | — | 1 | 5.9 |
| | | F | — | 0 | — | 0 | 0.0 | 0.0 | — | 0 | 0.0 |
| R:L foramen transversarium | | | | | | | | | | | |
| | R = L | M | | | | | | | 4 | 0 | 0.0 |
| | | F | | | | | | | 1 | 0 | 0.0 |
| | R > L | M | | | | | | | — | 2 | 50.0 |
| | | F | | | | | | | — | 1 | 100.0 |
| | R < L | M | | | | | | | — | 2 | 50.0 |
| | | F | | | | | | | — | 0 | 0.0 |
| Superior articular surface | | | | | | | | | | | |
| | Single | M | 9 | 9 | 10 | 10 | 100.0 | 100.0 | 19 | 19 | 100.0 |
| | | F | 7 | 7 | 7 | 7 | 100.0 | 100.0 | 14 | 14 | 100.0 |
| C-7 | | | | | | | | | | | |
| Foramen transversarium | | | | | | | | | | | |
| | Single | M | 7 | 6 | 5 | 5 | 85.7 | 100.0 | 12 | 11 | 91.7 |
| | | F | 6 | 5 | 4 | 2 | 83.3 | 50.0 | 10 | 7 | 70.0 |
| | Double | M | — | 0 | — | 0 | 0.0 | 0.0 | — | 0 | 0.0 |
| | | F | — | 1 | — | 1 | 16.7 | 25.0 | — | 2 | 20.0 |
| | Spurred | M | — | 1 | — | 0 | 14.3 | 0.0 | — | 1 | 8.3 |
| | | F | — | 0 | — | 1 | 0.0 | 25.0 | — | 1 | 10.0 |
| R:L foramen transversarium | | | | | | | | | | | |
| | R = L | M | | | | | | | 3 | 0 | 0.0 |
| | | F | | | | | | | 0 | 0 | 0.0 |
| | R > L | M | | | | | | | — | 3 | 100.0 |
| | | F | | | | | | | — | 0 | 0.0 |
| | R < L | M | | | | | | | — | 0 | 0.0 |
| | | F | | | | | | | — | 0 | 0.0 |

TABLE 21—Continued

| AREA | VARIATION | SEX | RIGHT *n* | RIGHT N | LEFT *n* | LEFT N | RIGHT % | LEFT % | TOTAL (RL) *n* | TOTAL (RL) N | TOTAL (RL) % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Superior articular surface | | | | | | | | | | | |
| | Single | M | 11 | 1 | 11 | 0 | 9.1 | 0.0 | 22 | 1 | 4.5 |
| | | F | 8 | 0 | 7 | 0 | 0.0 | 0.0 | 15 | 0 | 0.0 |
| | Double | M | — | 10 | — | 11 | 90.9 | 100.0 | — | 21 | 95.5 |
| | | F | — | 8 | — | 7 | 100.0 | 100.0 | — | 15 | 100.0 |

## TABLE 22

## SUMMARY OF VARIATIONS OF THE SPINOUS PROCESS OF THE CERVICAL VERTEBRAE

| VERTEBRA | VARIATION | *n* (M/F) | NUMBER (M/F) | | % (M/F) | TOTAL % |
|---|---|---|---|---|---|---|
| C-2 | Bifid: parallel | 13/5 | M | 5 | 38.5 | 38.9 |
| | | | F | 2 | 40.0 | |
| | Bifid: divergent | | M | 8 | 61.5 | 61.1 |
| | | | F | 3 | 60.0 | |
| C-3 | Non-bifid (single) | 5/3 | M | 2 | 40.0 | 37.5 |
| | | | F | 1 | 33.3 | |
| | Bifid: parallel | | M | 0 | 0.0 | 0.0 |
| | | | F | 0 | 0.0 | |
| | Bifid: divergent | | M | 3 | 60.0 | 62.5 |
| | | | F | 2 | 66.7 | |
| C-4 | Bifid: parallel | 6/5 | M | 2 | 33.3 | 18.2 |
| | | | F | 0 | 0.0 | |
| | Bifid: divergent | | M | 4 | 66.7 | 54.5 |
| | | | F | 2 | 40.0 | |
| | Non-bifid (single) | | M | 0 | 0.0 | 27.3 |
| | | | F | 3 | 60.0 | |
| C-5 | Non-bifid (single) | 3/5 | M | 1 | 33.3 | 37.5 |
| | | | F | 2 | 40.0 | |
| | Bifid: parallel | | M | 1 | 33.3 | 37.5 |
| | | | F | 2 | 40.0 | |
| | Bifid: divergent | | M | 1 | 33.3 | 25.0 |
| | | | F | 1 | 20.0 | |
| C-6 | Non-bifid (single) | 6/6 | M | 3 | 50.0 | 58.3 |
| | | | F | 4 | 66.7 | |
| | Bifid: parallel | | M | 1 | 16.7 | 16.7 |
| | | | F | 1 | 16.7 | |
| | Bifid: divergent | | M | 2 | 33.3 | 25.0 |
| | | | F | 1 | 16.7 | |
| C-7 | Non-bifid (single) | 12/6 | M | 10 | 83.3 | 88.9 |
| | | | F | 6 | 100.0 | |
| | Bifid: parallel | | M | 2 | 16.7 | 11.1 |
| | | | F | 0 | 0.0 | |

| Total | C-2 to C-6 | | C-7 | |
|---|---|---|---|---|
| Bifid: parallel | 14/57 | 24.6% | 2/18 | 11.1% |
| Bifid: divergent | 27/57 | 47.4 | 0/18 | 0.0 |
| Non-bifid (single) | 16/57 | 28.1 | 16/18 | 88.9 |

## TABLE 23

## SUMMARY OF LAMINAL SPURRING IN THE THORACIC AND LUMBAR VERTEBRAE

| VERTEBRA | n (M/F) | N (M/F) | % (M/F) | TOTAL PERCENTAGES | | | |
|---|---|---|---|---|---|---|---|
| T-1 | M 13 | 4 | 30.8 | M 48.7 | 42.6 | M 65.9 | 71.5 |
| | F 6 | 1 | 16.7 | F 26.7 | | F 82.1 | |
| T-2 | M 14 | 6 | 42.9 | | | | |
| | F 5 | 2 | 40.0 | | | | |
| T-3 | M 12 | 9 | 75.0 | | | | |
| | F 4 | 1 | 25.0 | | | | |
| T-4 | M 10 | 7 | 70.0 | M 64.3 | 79.6 | | |
| | F 5 | 5 | 100.0 | F 100.0 | | | |
| T-5 | M 8 | 5 | 62.5 | | | | |
| | F 8 | 8 | 100.0 | | | | |
| T-6 | M 10 | 6 | 60.0 | | | | |
| | F 8 | 8 | 100.0 | | | | |
| T-7 | M 10 | 8 | 80.0 | M 83.9 | 90.0 | | |
| | F 8 | 8 | 100.0 | F 100.0 | | | |
| T-8 | M 11 | 9 | 81.8 | | | | |
| | F 5 | 5 | 100.0 | | | | |
| T-9 | M 10 | 9 | 90.0 | | | | |
| | F 6 | 6 | 100.0 | | | | |
| T-10 | M 9 | 7 | 77.8 | M 71.4 | 77.5 | | |
| | F 5 | 5 | 100.0 | F 91.7 | | | |
| T-11 | M 10 | 8 | 80.0 | | | | |
| | F 3 | 2 | 66.7 | | | | |
| T-12 | M 9 | 5 | 55.6 | | | | |
| | F 4 | 4 | 100.0 | | | | |
| L-1 | M 8 | 2 | 25.0 | M 26.3 | 35.0 | | |
| | F 6 | 5 | 83.3 | F 50.0 | | | |
| L-2 | M 7 | 3 | 42.9 | | | | |
| | F 4 | 1 | 25.0 | | | | |
| L-3 | M 8 | 2 | 25.0 | | | | |
| | F 5 | 3 | 60.0 | | | | |
| L-4 | M 8 | 2 | 25.0 | | | | |
| | F 3 | 1 | 33.3 | | | | |
| L-5 | M 7 | 1 | 14.3 | | | | |
| | F 4 | 1 | 25.0 | | | | |

## TABLE 24

## MORPHOLOGICAL VARIATION FOUND IN THE LUMBAR AND SACRAL VERTEBRAE

| TRAIT VARIATION | *n* (M/F) | NUMBER | PERCENTAGE | TOTAL (ADULTS) | | |
|---|---|---|---|---|---|---|
| | | | | *n* | N | % |
| Lumbarization of S-1 | M 7 | 0 | 0.0 | 14 | 0 | 0.0 |
| | F 4 | 0 | 0.0 | | | |
| Sacralization of L-5 | M 7 | 0 | 0.0 | 14 | 0 | 0.0 |
| | F 4 | 0 | 0.0 | | | |
| Superior sacral hiatus | M 6 | | | 12 | | |
| | F 4 | | | | | |
| to mid-S-1 | M | 0 | 0.0 | | 0 | 0.0 |
| | F | 0 | 0.0 | | | |
| S-1/S-2 junction | M | 1 | 16.7 | | 3 | 25.0 |
| | F | 1 | 25.0 | | | |
| Mid-S-2 | M | 0 | 0.0 | | 0 | 0.0 |
| | F | 0 | 0.0 | | | |
| S-2/S-3 | M | 1 | 16.7 | | 1 | 8.3 |
| | F | 0 | 0.0 | | | |
| Inferior sacral hiatus | M 8 | | | 15 | | |
| | F 4 | | | | | |
| Mid-S-5 | M | 0 | 0.0 | | 0 | 0.0 |
| | F | 0 | 0.0 | | | |
| S-5/S-4 | M | 2 | 25.0 | | 2 | 13.3 |
| | F | 0 | 0.0 | | | |
| Mid-S-4 | M | 1 | 12.5 | | 2 | 13.3 |
| | F | 1 | 25.0 | | | |
| S-4/S-3 | M | 3 | 37.5 | | 4 | 26.7 |
| | F | 1 | 25.0 | | | |
| Mid-S-3 | M | 1 | 0.0 | | 1 | 6.7 |
| | F | 0 | 0.0 | | | |
| S-3/S-2 | M | 0 | 0.0 | | 2 | 13.3 |
| | F | 1 | 25.0 | | | |
| ? | M | 1 | 12.5 | | 1 | 6.7 |
| | F | 0 | 0.0 | | | |

## TABLE 25

## SUBADULT MORPHOLOGY

Spinous Process Form

| Vertebra | (P) Parallel | (D) Divided | (S) Single | *n* | Incidences | | |
|---|---|---|---|---|---|---|---|
| | | | | | P | D | S |
| C-2 | 0 | 3 | 0 | 3 | — | 100.0 | — |
| C-3 | 0 | 1 | 2 | 3 | — | 33.3 | 66.7 |
| C-4 | 0 | 1 | 0 | 1 | — | 100.0 | — |
| C-5 | 0 | 2 | 0 | 2 | — | 100.0 | — |
| C-6 | 0 | 3 | 0 | 3 | — | 100.0 | — |
| C-7 | 0 | 2 | 1 | 3 | — | 66.7 | 33.3 |

Foramen Transversarium Variation

| Vertebra | Single | Double | R = L | R < L | R > L |
|---|---|---|---|---|---|
| C-1 | 5/5 | 0/5 | 5/5 | 0/5 | 0/5 |
| | 100.0 | — | 100.0 | — | — |
| C-2 | 3/4 | 0/4 | 3/4 | 1/4 | 0/4 |
| | 75.0 | — | 75.0 | 25.0 | — |
| C-3 | 4/4 | 0/4 | 4/4 | 0 | 0 |
| | 100.0 | — | 100.0 | — | — |
| C-4 | 4/4 | 0/4 | 2/4 | 2/4 | 0/4 |
| | 100.0 | — | 50.0 | 50.0 | — |
| C-5 | 3/3 | 0/3 | 3/3 | 0/3 | 0/3 |
| | 100.0 | — | 100.0 | — | — |
| C-6 | 1/2 | 1/1 | 2/2 | 0/2 | 0/2 |
| | 50.0 | 100.0 | 100.0 | — | — |
| C-7 | 2/2 | 0/2 | 1/2 | 0/2 | 1/2 |
| | 100.0 | — | 50.0 | — | 50.0 |

Laminal Spurring

| Vertebra | Yes | No | % Yes | % No |
|---|---|---|---|---|
| T-2 | 0 | 3 | — | 100.0 |
| T-3 | 0 | 3 | — | 100.0 |
| T-3 | 0 | 0 | — | 100.0 |
| T-4 | 1 | 2 | 33.3 | 66.7 |
| T-5 | 2 | 1 | 66.7 | 33.3 |
| T-6 | 2 | 1 | 66.7 | 33.3 |
| T-7 | 2 | 1 | 66.7 | 33.3 |
| T-8 | 2 | 1 | 66.7 | 33.3 |
| T-9 | 2 | 1 | 66.7 | 33.3 |
| T-10 | 2 | 1 | 66.7 | 33.3 |
| T-11 | 2 | 1 | 66.7 | 33.3 |
| T-12 | 2 | 1 | 66.7 | 33.3 |
| L-1 | 1 | 2 | 33.3 | 66.7 |
| L-2 | 1 | 2 | 33.3 | 66.7 |
| L-3 | 1 | 3 | 25.0 | 75.0 |
| L-4 | 1 | 3 | 25.0 | 75.0 |
| L-5 | 1 | 3 | 25.0 | 75.0 |

# TABLE 26

## INFRACRANIAL MEASUREMENTS

| BONE | MEASUREMENT | SIDE/INDIVIDUAL | MALE *n* | MALE RANGE | MALE MEAN | MALE S.D. | FEMALE *n* | FEMALE RANGE | FEMALE MEAN | FEMALE S.D. |
|---|---|---|---|---|---|---|---|---|---|---|
| CLAVICLE | Maximum length | R | 7 | 13.0- 15.0 | 14.0 | 0.66 | 4 | 13.1- 15.2 | 14.1 | 0.77 |
| | | L | 6 | 13.2- 14.9 | 13.9 | 0.55 | 4 | 12.8- 15.4 | 13.8 | 1.05 |
| | | I | 9 | 13.2- 15.0 | 14.1 | 0.63 | 5 | 12.8- 15.4 | 13.9 | 9.54 |
| HUMERUS | Maximum length | R | 7 | 30.9- 33.4 | 32.4 | 0.75 | 6 | 29.7- 35.9 | 32.3 | 2.22 |
| | | L | 9 | 30.8- 33.6 | 32.2 | 0.92 | 3 | 32.1- 36.0 | | |
| | | I | 10 | 30.8- 33.6 | 32.3 | 0.89 | 7 | 29.7- 36.0 | 28.1 | 10.37 |
| | Minimum head diameter | R | 9 | 3.9- 4.4 | 4.3 | 0.13 | 6 | 3.5- 4.5 | 4.0 | 0.36 |
| | | L | 6 | 4.1- 4.4 | 4.3 | 0.11 | 6 | 3.7- 4.4 | 4.0 | 0.76 |
| | | I | 10 | 3.9- 4.4 | 4.2 | 0.14 | 8 | 3.5- 4.5 | 4.0 | 3.3 |
| | Maximum head diameter | R | 10 | 4.2- 4.8 | 4.6 | 0.17 | 7 | 4.0- 4.9 | 4.3 | 0.35 |
| | | L | 9 | 4.1- 4.9 | 4.5 | 0.27 | 6 | 3.6- 5.0 | 4.2 | 0.43 |
| | | I | 11 | 4.2- 4.8 | 4.5 | 0.25 | 9 | 3.6- 5.0 | 4.2 | 4.3 |
| RADIUS | Maximum length | R | 6 | 24.0- 26.1 | 25.2 | 0.89 | 3 | 20.5- 26.0 | 22.9 | 2.0 |
| | | L | 6 | 23.7- 25.4 | 24.5 | 0.66 | 2 | 23.0- 25.8 | 24.4 | 1.40 |
| | | I | 7 | 23.7- 26.1 | 24.8 | 0.82 | 4 | 20.5- 25.8 | 22.9 | 1.91 |
| | Maximum head diameter | R | 9 | 2.2- 2.4 | 2.4 | 0.13 | 3 | 2.0- 2.8 | 2.3 | 0.38 |
| | | L | 7 | 2.2- 2.6 | 2.4 | 0.12 | 3 | 2.1- 2.7 | 2.4 | 0.24 |
| | | I | 10 | 2.2- 2.6 | 2.5 | 0.12 | 5 | 2.0- 2.7 | 2.2 | 0.27 |
| ULNA | Maximum length | R | 8 | 25.2- 28.6 | 26.9 | 1.0 | 5 | 23.0- 27.5 | 25.3 | 1.6 |
| | | L | 5 | 25.0- 26.9 | 26.3 | 1.1 | 2 | 25.8- 28.0 | 26.9 | 1.1 |
| | | I | 9 | 25.0- 28.6 | 26.7 | 1.1 | 5 | 23.0- 28.0 | 25.3 | 1.7 |
| FEMUR | Maximum length | R | 4 | 44.9- 47.4 | 46.1 | 0.9 | 3 | 42.3- 51.2 | 46.4 | 3.66 |
| | | L | 6 | 44.3- 47.4 | 45.7 | 1.0 | 3 | 41.9- 50.9 | 46.3 | 3.68 |
| | | I | 7 | 44.3- 47.4 | 45.7 | 0.93 | 4 | 41.9- 50.9 | 45.3 | 3.6 |
| | Maximum head diameter | R | 7 | 4.6- 5.0 | 4.8 | 0.15 | 6 | 4.1- 5.2 | 4.5 | 0.34 |
| | | L | 8 | 4.6- 5.0 | 4.8 | 0.13 | 4 | 4.2- 5.2 | 4.6 | 0.36 |
| | | I | 11 | 4.6- 5.0 | 4.8 | 0.14 | 6 | 4.2- 5.2 | 4.6 | 0.31 |

TABLE 26—Continued

| | | | MALE | | | | FEMALE | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| BONE | MEASUREMENT | SIDE/INDIVIDUAL | *n* | RANGE | MEAN | S.D. | *n* | RANGE | MEAN | S.D. |
| | Subtrochanteric Ant.-post diameter | R | 8 | 2.4- 3.0 | 2.7 | 0.19 | 9 | 2.3- 3.1 | 2.6 | 0.23 |
| | | L | 8 | 2.5- 3.0 | 2.7 | 0.17 | 5 | 2.3- 2.8 | 2.5 | 0.19 |
| | | I | 10 | 2.5- 3.0 | 2.7 | 0.18 | 9 | 2.3- 2.8 | 2.6 | 0.26 |
| | Lat. diameter | R | 8 | 2.7- 3.5 | 3.2 | 0.23 | 9 | 3.1- 3.5 | 3.1 | 0.41 |
| | | L | 8 | 3.1- 3.7 | 3.3 | 0.18 | 5 | 3.0- 3.5 | 3.3 | 0.20 |
| | | I | 9 | 3.1- 3.7 | 3.3 | 0.17 | 9 | 3.0- 3.5 | 3.3 | 0.19 |
| | Platymeric index | R | 8 | 72.7- 93.8 | 84.8 | 0.72 | 9 | 65.7- 90.3 | 79.7 | 7.07 |
| | | L | 8 | 75.8- 88.8 | 81.9 | 0.39 | 5 | 65.7- 98.8 | 76.7 | 9.34 |
| | | I | 10 | 75.8- 93.8 | 83.6 | 5.2 | 9 | 65.7- 98.8 | 81.8 | 10.7 |
| | Mid-shaft transverse diameter | R | 11 | 2.5- 3.0 | 2.7 | 0.17 | 7 | 2.4- 3.4 | 2.6 | 0.18 |
| | | L | 8 | 2.5- 3.0 | 2.7 | 0.14 | 9 | 2.3- 2.9 | 2.6 | 0.17 |
| | | I | 14 | 2.5- 3.0 | 2.7 | 0.17 | 10 | 2.3- 2.9 | 2.6 | 0.18 |
| | Ant.-post diameter | R | 11 | 2.7- 3.6 | 3.1 | 0.30 | 7 | 2.7- 3.4 | 3.0 | 0.23 |
| | | L | 8 | 2.7- 3.6 | 3.1 | 0.29 | 9 | 2.5- 3.4 | 2.9 | 0.26 |
| | | I | 14 | 2.7- 3.7 | 3.1 | 0.31 | 10 | 2.5- 3.4 | 3.6 | 0.24 |
| | Pilastric index | R | 11 | 100.0-136.0 | 116.9 | 0.12 | 7 | 107.4-125.0 | 113.7 | 0.57 |
| | | L | 8 | 100.0-123.1 | 114.3 | 0.83 | 9 | 100.0-121.7 | 110.7 | 0.68 |
| | | I | 14 | 100.0-123.3 | 114.8 | 10.2 | 9 | 100.0-121.7 | 110.7 | 6.82 |
| TIBIA | Maximum length | R | 6 | 36.3- 39.8 | 38.5 | 1.11 | 3 | 38.1- 41.2 | 39.6 | 1.27 |
| | | L | 3 | 35.0- 39.5 | 37.6 | 1.90 | 3 | 35.7- 41.9 | 38.5 | 2.56 |
| | | I | 7 | 36.3- 39.5 | 37.9 | 1.5 | 5 | 35.7- 41.9 | 38.6 | 2.0 |
| | Transverse diameter | R | 9 | 2.1- 2.9 | 2.6 | 0.29 | 8 | 2.2- 2.9 | 2.6 | 0.22 |
| | | L | 10 | 2.1- 3.0 | 2.5 | 0.27 | 8 | 2.3- 2.7 | 2.5 | 0.13 |
| | | I | 13 | 2.1- 3.1 | 2.5 | 0.29 | 10 | 2.3- 2.9 | 2.6 | 0.18 |
| | Ant.-post diameter | R | 9 | 3.4- 4.4 | 3.9 | 0.29 | 8 | 3.4- 4.0 | 3.7 | 0.22 |
| | | L | 10 | 3.3- 4.4 | 3.8 | 0.36 | 8 | 3.3- 4.0 | 3.5 | 0.22 |
| | | I | 13 | 3.3- 4.4 | 3.8 | 0.33 | 10 | 3.3- 4.0 | 3.6 | 0.24 |
| | Platycnemic index | R | 9 | 50.0- 75.6 | 66.1 | 6.7 | 8 | 56.4- 79.4 | 70.6 | 6.3 |
| | | L | 10 | 48.8- 72.2 | 65.9 | 6.5 | 8 | 57.5- 76.5 | 70.6 | 5.7 |
| | | I | 13 | 48.8- 75.6 | 66.6 | 6.3 | 10 | 57.5- 76.5 | 71.1 | 5.2 |

### TABLE 26—Continued

| BONE | MEASUREMENT | SIDE/INDIVIDUAL | MALE *n* | MALE RANGE | MALE MEAN | MALE S.D. | FEMALE *n* | FEMALE RANGE | FEMALE MEAN | FEMALE S.D. |
|---|---|---|---|---|---|---|---|---|---|---|
| FIBULA | Maximum length | R | 2 | 37.3- 38.1 | 37.7 | 4.0 | 1 | — | 34.7 | — |
| | | L | 2 | 37.2- 38.6 | 37.2 | 4.5 | 1 | — | 39.9 | — |
| | | I | 3 | 37.3- 38.6 | 38.0 | 0.53 | 1 | — | 39.9 | — |
| PATELLA | Length | R | 7 | 4.1- 4.8 | 4.4 | 0.25 | 6 | 3.6- 4.9 | 4.1 | 0.45 |
| | | L | 5 | 4.2- 4.6 | 4.4 | 0.15 | 8 | 3.6- 4.9 | 4.1 | 0.40 |
| | Width | R | 7 | 4.1- 4.7 | 4.4 | 0.18 | 6 | 3.5- 4.9 | 4.2 | 0.42 |
| | | L | 5 | 4.3- 4.9 | 4.6 | 0.19 | 8 | 3.8- 4.9 | 4.2 | 0.36 |
| | Height | R | 7 | 1.9- 2.3 | 2.1 | 0.13 | 6 | 1.9- 2.1 | 2.0 | 0.06 |
| | | L | 5 | 2.1- 2.3 | 2.2 | 0.09 | 9 | 1.9- 2.1 | 2.0 | 0.29 |
| | Module | R | 7 | 3.4- 3.9 | 3.6 | 0.15 | 6 | 3.0- 4.0 | 3.5 | 0.30 |
| | | L | 5 | 3.6- 3.9 | 3.7 | 0.11 | 9 | 3.1- 4.0 | 3.5 | 0.03 |
| LUMBAR VERTEBRAE | L1 Post. height | | 4 | 2.5- 2.9 | 2.7 | 0.18 | 6 | 2.6- 3.0 | 2.8 | 0.18 |
| | Ant. height | | 3 | 2.4- 2.5 | 2.4 | 0.05 | 6 | 2.4- 2.9 | 2.6 | 0.19 |
| | Lumbar index | | 3 | 104.2-116.0 | 109.5 | 4.91 | 6 | 103.4-116.7 | 108.6 | 4.5 |
| | L2 Post. height | | 5 | 2.7- 3.0 | 2.8 | 0.26 | 4 | 2.7- 3.0 | 2.9 | 0.13 |
| | Ant. height | | 4 | 2.4- 2.6 | 2.5 | 0.07 | 4 | 2.6- 3.0 | 2.8 | 0.14 |
| | Index | | 4 | 108.0-120.0 | 113.0 | 4.4 | 4 | 100.0-107.1 | 102.7 | 3.0 |
| | L3 Post. height | | 8 | 2.6- 3.0 | 2.7 | 0.09 | 4 | 2.3- 2.9 | 2.7 | 0.12 |
| | Ant. height | | 7 | 2.4- 2.7 | 2.6 | 5.3 | 4 | 2.4- 3.0 | 2.7 | 0.21 |
| | Index | | 7 | 100.0-115.4 | 106.6 | 5.3 | 4 | 86.7-108.3 | 101.1 | 7.9 |
| | L4 Post. height | | 7 | 2.4- 2.8 | 2.6 | 0.15 | 4 | 2.5- 3.1 | 2.7 | 0.25 |
| | Ant. height | | 5 | 2.4- 2.8 | 2.6 | 0.14 | 4 | 2.5- 2.8 | 2.7 | 0.13 |
| | Index | | 5 | 96.0-107.7 | 100.1 | 5.4 | 4 | 89.3-110.7 | 100.0 | 7.6 |
| | L5 Post. height | | 8 | 2.4- 2.8 | 2.6 | 0.12 | 5 | 2.4- 2.9 | 2.6 | 0.83 |
| | Ant. height | | 8 | 2.2- 3.0 | 2.7 | 0.21 | 5 | 2.5- 2.9 | 2.7 | 0.21 |
| | Index | | 8 | 83.3-108.0 | 95.3 | 6.6 | 5 | 88.9-100.0 | 94.2 | 4.2 |
| L1-5 | Vertebral index | | 1 | | 108.2 | | 3 | | 101.1 | |

## TABLE 27

## MORPHOLOGICAL VARIATION AS FOUND IN THE INFRACRANIAL SKELETON

| BONE | TRAIT | VARIATION | MALE | | | | | | FEMALE | | | | | | GRAND TOTAL | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | N R | N L | N T | % R | % L | % T | N R | N L | N T | % R | % L | % T | RL | % |
| SCAPULA | Suprascapular | *n* | 6 | 6 | 12 | — | — | — | 2 | 2 | 4 | — | — | — | 16 | — |
| | | Nothing | 0 | 2 | 2 | 0.0 | 33.3 | 16.7 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 2 | 12.5 |
| | | Notch | 6 | 4 | 10 | 100.0 | 66.7 | 83.3 | 2 | 1 | 3 | 100.0 | 50.0 | 75.0 | 13 | 81.3 |
| | | Foramen | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 1 | 1 | 0.0 | 50.0 | 25.0 | 1 | 6.2 |
| | Acromion | *n* | 6 | 6 | 12 | — | — | — | 3 | 2 | 5 | — | — | — | 17 | — |
| | | Rectangle | 4 | 6 | 10 | 66.7 | 100.0 | 83.3 | 2 | 1 | 3 | 66.7 | 50.0 | 60.0 | 13 | 76.5 |
| | | Triangle | 1 | 0 | 1 | 16.7 | 0.0 | 8.3 | 1 | 1 | 2 | 33.3 | 50.0 | 40.0 | 3 | 17.6 |
| | | Sickle | 1 | 0 | 1 | 16.7 | 0.0 | 8.3 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 5.9 |
| | Inf. angle | *n* | 2 | 2 | 4 | — | — | — | 1 | 1 | 2 | — | — | — | 6 | — |
| | | V-shaped | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 1 | 2 | 100.0 | 100.0 | 100.0 | 2 | 33.3 |
| | | U-shaped | 2 | 2 | 4 | 100.0 | 100.0 | 100.0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 4 | 66.7 |
| HUMERUS | Supratrochlear spur | *n* | 14 | 14 | 28 | — | — | — | 8 | 2 | 10 | — | — | — | 45 | — |
| | | Presence | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 0.0 |
| | Septal aperture | *n* | 11 | 12 | 23 | — | — | — | 8 | 2 | 10 | — | — | — | 39 | — |
| | | Presence | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 0 | 1 | 12.5 | 0.0 | 10.0 | 6 | 15.4 |
| INNOMINATE | Acetabular notch | *n* | 8 | 10 | 18 | — | — | — | 3 | 2 | 5 | — | — | — | 23 | — |
| | | Presence | 2 | 3 | 5 | 25.0 | 30.0 | 27.8 | 2 | 1 | 3 | 66.7 | 50.0 | 60.0 | 8 | 34.8 |
| FEMUR | Fossa of Allen | *n* | 6 | 7 | 13 | — | — | — | 2 | 2 | 4 | — | — | — | 24 | — |
| | | Presence | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 2 | 8.3 |
| | Third trochanter | *n* | 7 | 8 | 15 | — | — | — | 3 | 4 | 7 | — | — | — | 31 | — |
| | | None | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 3.2 |
| | | Presence | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 0.0 |
| | | Ridge | 7 | 8 | 15 | 100.0 | 100.0 | 100.0 | 3 | 4 | 7 | 100.0 | 100.0 | 100.0 | 30 | 96.8 |
| TIBIA | Tibia squatting facet | *n* | 2 | 1 | 3 | — | — | — | 1 | 2 | 3 | — | — | — | 12 | — |
| | | Medial | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 3 | 25.0 |
| | | Lateral | 1 | 1 | 2 | 50.0 | 100.0 | 66.7 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 3 | 25.0 |
| | | Neck | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 2 | 3 | 100.0 | 100.0 | 100.0 | 3 | 25.0 |

TABLE 27—Continued

| | | | MALE | | | | | | FEMALE | | | | | | GRAND TOTAL | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | N | | | % | | | N | | | % | | | | |
| BONE | TRAIT | VARIATION | R | L | T | R | L | T | R | L | T | R | L | T | RL | % |
| Talus | | *n* | 12 | 12 | 24 | — | — | — | 5 | 6 | 11 | — | — | — | 35 | — |
| | Talar squatting facet | Medial | 4 | 4 | 8 | 33.3 | 33.3 | 33.3 | 1 | 3 | 4 | 20.0 | 50.0 | 36.4 | 12 | 34.3 |
| | | Neck | 2 | 1 | 3 | 16.7 | 8.3 | 12.5 | 1 | 2 | 3 | 20.0 | 33.3 | 27.3 | 6 | 17.1 |
| | | Med. + Lat. | 1 | 1 | 2 | 8.3 | 8.3 | 8.3 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 2 | 5.7 |
| | | Med. + Neck | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 0 | 1 | 10.0 | 0.0 | 9.1 | 1 | 2.9 |
| | | Lat. + Neck | 0 | 1 | 1 | 0.0 | 8.3 | 4.2 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 2.9 |
| | | M + L + N | 1 | 1 | 2 | 8.3 | 8.3 | 8.3 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 2 | 5.7 |
| | | *n* | 3 | 2 | 5 | — | — | — | 1 | 3 | 4 | — | — | — | 9 | — |
| | Talar extension | Medial | 0 | 1 | 1 | 0.0 | 50.0 | 20.0 | 0 | 1 | 1 | 0.0 | 33.3 | 25.0 | 4 | 44.4 |
| | | Lateral | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 1 | 1 | 0.0 | 33.3 | 25.0 | 1 | 11.1 |
| | | Med. + Lat. | 1 | 0 | 1 | 33.3 | 0.0 | 20.0 | 0 | 1 | 1 | 0.0 | 33.3 | 25.0 | 2 | 22.2 |
| | | *n* | — | — | 4 | — | — | — | — | — | 2 | — | — | — | 6 | — |
| Sternum | Sternal aperture | Presence | — | — | 0 | — | — | 0.0 | — | — | 0 | — | — | 0.0 | 0 | 0.0 |
| | | *n* | 9 | 8 | 17 | — | — | — | 4 | 4 | 8 | — | — | — | 25 | — |
| Patella | Vastus notch | Presence | 0 | 1 | 1 | 0.0 | 12.5 | 5.9 | 1 | 1 | 2 | 25.0 | 25.0 | 25.0 | 3 | 12.0 |
| | | *n* | 6 | 7 | 13 | — | — | — | 3 | 7 | 10 | — | — | — | 23 | — |
| Navicular | Posterior navicular surface | Inf. extens. | 3 | 6 | 9 | 50.0 | 85.7 | 69.2 | 2 | 4 | 6 | 66.7 | 57.1 | 60.0 | 15 | 65.2 |
| | | Tub. pitted | 3 | 1 | 4 | 50.0 | 14.3 | 30.8 | 1 | 3 | 4 | 33.3 | 42.9 | 40.0 | 8 | 34.8 |
| | | *n* | 13 | 13 | 26 | — | — | — | 5 | 5 | 10 | — | — | — | 36 | — |
| Calcaneus | Calcaneal facet | Single | 1 | 1 | 2 | 7.7 | 7.7 | 7.7 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 2 | 5.6 |
| | | Double | 4 | 2 | 6 | 30.8 | 15.4 | 23.1 | 1 | 1 | 2 | 20.0 | 20.0 | 20.0 | 8 | 22.2 |
| | | Constricted | 8 | 10 | 18 | 61.5 | 76.9 | 69.2 | 4 | 4 | 8 | 80.0 | 80.0 | 80.0 | 26 | 72.2 |

## TABLE 28

## SUBADULT INFRACRANIAL MORPHOLOGY

| TRAIT | VARIATION | *n* | N | % | TOTAL (ADULT-SUBADULT & RL) | | |
|---|---|---|---|---|---|---|---|
| | | | | | *n* | N | % |
| Sternal aperture | | | | | | | |
| | Presence | 3 | 0 | 0.0 | 9 | 0 | 0.0 |
| Suprascapular notch | | | | | | | |
| | Right | 1 | 1 | 100.0 | | | |
| | Left | 1 | 1 | 100.0 | | | |
| | Total | 2 | 2 | 100.0 | 18 | 15 | 83.3 |
| Acromion (rectangular) | | | | | | | |
| | Right | 2 | 2 | 100.0 | | | |
| | Left | 1 | 1 | 100.0 | | | |
| | Total | 3 | 3 | 100.0 | 20 | 16 | 80.0 |
| Inferior angle (V) | | | | | | | |
| | Right | 1 | 1 | 100.0 | | | |
| | Left | 1 | 1 | 100.0 | | | |
| | Total | 2 | 2 | 100.0 | | | |
| Supratrochlear spur | | | | | | | |
| | Right | 4 | 0 | 0.0 | | | |
| | Left | 3 | 0 | 0.0 | | | |
| | Total | 7 | 0 | 0.0 | 52 | 0 | 0.0 |
| Septal aperture | | | | | | | |
| | Right | 2 | 0 | 0.0 | | | |
| | Left | 3 | 0 | 0.0 | | | |
| | Total | 5 | 0 | 0.0 | 44 | 6 | 13.6 |
| Acetabular notch | | | | | | | |
| | Right | 2 | 0 | 0.0 | | | |
| | Left | 1 | 1 | 100.0 | | | |
| | Total | 3 | 1 | 33.3 | 26 | 9 | 34.6 |
| Vastus notch | | | | | | | |
| | Right | 0 | — | — | | | |
| | Left | 1 | 0 | 0.0 | 26 | 4 | 15.4 |
| T-3 (ridge) | | | | | | | |
| | Right | 3 | 3 | 100.0 | | | |
| | Left | 2 | 2 | 100.0 | | | |
| | Total | 5 | 5 | 100.0 | 36 | 35 | 97.2 |
| Talar facet | | | | | | | |
| | Right | 0 | — | — | | | |
| | Left | 1 | 0 | 0.0 | | | |
| Calcaneus (constricted) | | | | | | | |
| | Right | 0 | — | — | | | |
| | Left | 1 | 1 | 100.0 | | | |
| | Total | 1 | 1 | 100.0 | 37 | 27 | 73.0 |

## TABLE 29

## STATURE ESTIMATIONS FOR THE ADULT SERIES

| CATALOGUE NUMBER | BASED ON MONGOLOID FORMULAE cm | BASED ON CAUCASOID FORMULAE cm |
|---|---|---|
| Male | | |
| To-At-1- 7 | 165.1 ± 3.27 | 166.6 ± 4.00 |
| To-At-1-10 | 168.7 ± 3.24 | 168.6 ± 3.74 |
| To-At-1-10B | 170.8 ± 3.80 | 171.6 ± 3.94 |
| To-At-1-12 | 170.1 ± 4.60 | 173.8 ± 4.66 |
| To-At-1-16 | 172.1 ± 3.18 | 172.4 ± 3.62 |
| To-At-1-21A | 175.9 ± 3.24 | 176.1 ± 3.74 |
| To-At-1-29 | 171.5 ± 3.18 | 171.8 ± 3.62 |
| To-At-1-31 | 174.9 ± 3.27 | 176.6 ± 4.00 |
| To-At-1-34 | 171.9 ± 3.80 | 172.7 ± 3.94 |
| To-At-2- 6 | 175.9 ± 3.27 | 177.5 ± 4.00 |
| To-At-2-13 | 169.0 ± 4.25 | 170.6 ± 4.57 |
| To-At-2-13A | 168.4 ± 4.16 | 169.9 ± 4.41 |
| To-At-2-22 | 169.4 ± 4.16 | 171.0 ± 4.31 |
| To-At-2-31 | 170.4 ± 3.80 | 171.1 ± 3.94 |
| To-At-2-37 | 173.0 ± 3.27 | 174.6 ± 4.00 |
| To-At-2-42 | 165.7 ± 4.25 | 167.1 ± 4.57 |
| Female | | |
| To-At-1-11 | 169.2 ± 4.25 | 170.9 ± 4.57 |
| To-At-1-19 | 173.0 ± 3.24 | 173.1 ± 3.74 |
| To-At-2- 1C | 161.0 ± 4.16 | 161.9 ± 4.31 |
| To-At-2- 4 | 181.0 ± 3.18 | 182.0 ± 3.62 |
| To-At- 2-16 | 162.8 ± 4.25 | 163.9 ± 4.57 |
| To-At-2-20 | 172.5 ± 3.27 | 174.1 ± 4.00 |
| To-At-2-27 | 175.6 ± 3.27 | 177.3 ± 4.00 |
| To-At-2-27A | 162.7 ± 3.80 | 166.6 ± 3.94 |
| To-At-2-30 | 163.4 ± 4.60 | 166.6 ± 4.66 |
| To-At-2-40A | 162.3 ± 4.16 | 163.3 ± 4.31 |
| Range | | |
| M | 165.1 ± 3.27 - 175.9 ± 3.27 | 166.6 ± 4.00 - 177.5 ± 4.00 |
| F | 161.0 ± 4.16 - 181.0 ± 3.18 | 161.9 ± 4.31 - 182.0 ± 3.62 |

## TABLE 30

## LIMB PROPORTION INDICES

| INDIVIDUAL | BRACHIAL | TIBIO-FEMORAL | INTERMEMBRAL |
|---|---|---|---|
| To-At-1- 6 | 78.7 | 82.9 | 67.7 |
| To-At-1- 7 | 76.7 | — | — |
| To-At-1- 9 | 76.5 | — | — |
| To-At-1-19 | — | 82.4 | — |
| To-At-1-29 | 79.4 (R) | 87.1 (R) | 70.7 (R) |
| To-At-1-34 | 79.5 (R) | — | — |
| To-At-2- 4 | 71.7 | 82.3 | 66.6 |
| To-At-2-13C | 74.9 | — | — |
| To-At-2-22 | 73.9 | — | — |

## TABLE 31

## FREQUENCY OF OCCURRENCE OF ALL ARTHRITIC INVOLVEMENT AT THE SHOULDER, ELBOW, AND HIP ACCORDING TO SEX

| ARTICULAR SURFACE | *n* | | | NUMBER | | | PERCENTAGE | | |
|---|---|---|---|---|---|---|---|---|---|
| | M | F | T | M | F | T | M | F | TOTAL |
| R sterno-clavicle | 8 | 4 | 12 | 3 | 1 | 4 | 37.5 | 25.0 | 33.3 |
| L sterno-clavicle | 6 | 3 | 9 | 2 | 0 | 2 | 33.3 | 0.0 | 22.2 |
| Total | 14 | 7 | 21 | 5 | 1 | 6 | 35.7 | 14.3 | 28.6 |
| R acromion-clavicle | 9 | 3 | 12 | 2 | 1 | 3 | 22.2 | 33.3 | 25.0 |
| L acromion-clavicle | 3 | 2 | 5 | 1 | 1 | 2 | 33.3 | 50.0 | 40.0 |
| Total | 12 | 5 | 17 | 3 | 2 | 5 | 25.0 | 40.0 | 29.4 |
| R glenoid | 10 | 4 | 14 | 5 | 2 | 7 | 50.0 | 50.0 | 50.0 |
| L glenoid | 10 | 2 | 12 | 4 | 1 | 5 | 40.0 | 50.0 | 41.7 |
| Total | 20 | 6 | 26 | 9 | 3 | 12 | 45.0 | 50.0 | 46.2 |
| R humerus, head | 9 | 6 | 15 | 1 | 3 | 4 | 11.1 | 50.0 | 26.7 |
| L humerus, head | 8 | 2 | 10 | 2 | 0 | 2 | 25.0 | 0.0 | 20.0 |
| Total | 17 | 8 | 25 | 3 | 3 | 6 | 17.6 | 37.5 | 24.0 |
| R capitulum | 7 | 7 | 14 | 2 | 4 | 6 | 28.6 | 57.1 | 42.9 |
| L capitulum | 11 | 2 | 13 | 3 | 1 | 4 | 27.3 | 50.0 | 30.8 |
| Total | 18 | 9 | 27 | 5 | 5 | 10 | 27.8 | 55.6 | 37.0 |
| R trochlea | 7 | 8 | 15 | 3 | 4 | 7 | 42.9 | 50.0 | 46.7 |
| L trochlea | 10 | 2 | 12 | 3 | 2 | 5 | 30.0 | 100.0 | 41.7 |
| Total | 17 | 10 | 27 | 6 | 6 | 12 | 35.3 | 60.0 | 44.4 |
| R proximal ulna | 10 | 5 | 15 | 7 | 5 | 12 | 70.0 | 100.0 | 80.0 |
| L proximal ulna | 11 | 5 | 16 | 10 | 5 | 15 | 90.9 | 100.0 | 93.8 |
| Total | 21 | 10 | 31 | 17 | 10 | 27 | 81.0 | 100.0 | 87.1 |
| R sacro-iliac | 7 | 2 | 9 | 5 | 2 | 7 | 71.4 | 100.0 | 77.8 |
| L sacro-iliac | 6 | 1 | 7 | 3 | 1 | 4 | 50.0 | 100.0 | 57.1 |
| Total | 13 | 3 | 16 | 8 | 3 | 11 | 61.5 | 100.0 | 68.8 |
| R acetabulum | 10 | 4 | 14 | 2 | 1 | 3 | 20.0 | 25.0 | 21.4 |
| L acetabulum | 7 | 1 | 8 | 3 | 0 | 3 | 42.9 | 0.0 | 37.5 |
| Total | 17 | 5 | 22 | 5 | 1 | 6 | 29.4 | 20.0 | 27.3 |
| R femur, head | 4 | 4 | 8 | 0 | 1 | 1 | 0.0 | 25.0 | 12.5 |
| L femur, head | 4 | 1 | 5 | 0 | 1 | 1 | 0.0 | 100.0 | 20.0 |
| Total | 8 | 5 | 13 | 0 | 2 | 2 | 0.0 | 40.0 | 15.4 |

## TABLE 32

## SUMMARY OF ARTHRITIC INVOLVEMENT AT THE KNEE REGION

| ARTICULAR SURFACE | *n* | | | NUMBER | | | % | | |
|---|---|---|---|---|---|---|---|---|---|
| | M | F | T | M | F | T | M | F | T |
| R distal femur | 1 | 1 | 2 | 1 | 1 | 2 | 100.0 | 100.0 | 100.0 |
| L distal femur | 2 | 2 | 4 | 1 | 1 | 2 | 50.0 | 50.0 | 50.0 |
| Total (R & L) | 3 | 3 | 6 | 2 | 2 | 4 | 66.7 | 66.7 | 66.7 |
| R proximal tibia | 4 | 2 | 6 | 1 | 1 | 2 | 25.0 | 50.0 | 33.3 |
| L proximal tibia | 5 | 4 | 9 | 2 | 1 | 3 | 40.0 | 25.0 | 33.3 |
| Total | 9 | 6 | 15 | 3 | 2 | 5 | 33.3 | 33.3 | 33.3 |
| R patella | 9 | 4 | 13 | 6 | 2 | 8 | 66.7 | 50.0 | 61.5 |
| L patella | 10 | 5 | 15 | 5 | 1 | 6 | 50.0 | 20.0 | 40.0 |
| Total | 19 | 9 | 28 | 11 | 3 | 14 | 57.9 | 33.3 | 50.0 |
| R proximal fibula | 4 | 1 | 5 | 3 | 1 | 4 | 75.0 | 100.0 | 80.0 |
| L proximal fibula | 1 | 2 | 3 | 0 | 2 | 2 | 0.0 | 100.0 | 66.7 |
| Total | 5 | 3 | 8 | 3 | 3 | 6 | 60.0 | 100.0 | 75.0 |

## TABLE 33

## FREQUENCY OF OCCURRENCE OF ALL ARTHRITIC INVOLVEMENT IN THE WRIST REGION

| ARTICULAR SURFACE | *n* | | | NUMBER | | | % | | |
|---|---|---|---|---|---|---|---|---|---|
| | M | F | T | M | F | T | M | F | T |
| R distal radius | 9 | 4 | 13 | 6 | 4 | 10 | 66.7 | 100.0 | 76.9 |
| R distal ulna | 7 | 4 | 11 | 1 | 2 | 3 | 14.3 | 50.0 | 27.3 |
| L distal radius | 12 | 4 | 16 | 8 | 3 | 11 | 66.7 | 75.0 | 68.8 |
| L distal ulna | 5 | 2 | 7 | 2 | 1 | 3 | 40.0 | 50.0 | 42.9 |
| R pisiform | 3 | 4 | 7 | 2 | 2 | 4 | 66.7 | 50.0 | 57.1 |
| L pisiform | 2 | 1 | 3 | 1 | 0 | 1 | 50.0 | 0.0 | 33.3 |
| R hamate | 7 | 6 | 13 | 5 | 3 | 8 | 71.4 | 50.0 | 61.5 |
| L hamate | 8 | 2 | 10 | 6 | 0 | 6 | 75.0 | 0.0 | 60.0 |
| R capitate | 7 | 6 | 13 | 5 | 3 | 8 | 71.4 | 50.0 | 61.5 |
| L capitate | 7 | 4 | 11 | 5 | 0 | 5 | 71.4 | 0.0 | 45.5 |
| R trapezoid | 8 | 2 | 10 | 6 | 2 | 8 | 75.0 | 100.0 | 80.0 |
| L trapezoid | 3 | 1 | 4 | 1 | 0 | 1 | 33.3 | 0.0 | 25.0 |
| R trapezium | 4 | 2 | 6 | 4 | 2 | 6 | 100.0 | 100.0 | 100.0 |
| L trapezium | 7 | 1 | 8 | 6 | 0 | 6 | 85.7 | 0.0 | 75.0 |
| R scaphoid | 6 | 6 | 12 | 4 | 3 | 7 | 66.7 | 50.0 | 58.3 |
| L scaphoid | 6 | 3 | 9 | 5 | 0 | 5 | 83.3 | 0.0 | 55.6 |
| R lunate | 6 | 4 | 10 | 6 | 3 | 9 | 100.0 | 75.0 | 90.0 |
| L lunate | 3 | 0 | 3 | 2 | 0 | 2 | 66.7 | 0.0 | 66.7 |
| R triquetrum | 3 | 3 | 6 | 3 | 2 | 5 | 100.0 | 66.7 | 83.3 |
| L triquetrum | 5 | 1 | 6 | 4 | 0 | 4 | 80.0 | 0.0 | 66.7 |

## TABLE 34

## FREQUENCY OF OCCURRENCE OF ALL ARTHRITIC CHANGES ON THE PROXIMAL AND DISTAL EXTREMITIES OF THE METACARPALS ACCORDING TO MOUND ASSOCIATION

| ARTICULAR SURFACE | *n* | | | NUMBER | | | % | | |
|---|---|---|---|---|---|---|---|---|---|
| | I | II | TOTAL | I | II | TOTAL | I | II | TOTAL |
| R proximal MC-1 | 11 | 11 | 22 | 4 | 5 | 9 | 36.4 | 45.5 | 40.9 |
| L proximal MC-1 | 5 | 10 | 15 | 2 | 6 | 8 | 40.0 | 60.0 | 53.3 |
| Total | 16 | 21 | 37 | 6 | 11 | 17 | 37.5 | 52.4 | 45.9 |
| R distal MC-1 | 11 | 12 | 23 | 1 | 3 | 4 | 9.1 | 25.0 | 17.4 |
| L distal MC-1 | 5 | 11 | 16 | 1 | 3 | 4 | 20.0 | 27.3 | 25.0 |
| Total | 16 | 23 | 39 | 2 | 6 | 8 | 12.5 | 26.1 | 20.5 |
| R proximal MC-2 | 9 | 10 | 19 | 4 | 5 | 9 | 44.4 | 50.0 | 47.4 |
| L proximal MC-2 | 7 | 9 | 16 | 3 | 6 | 9 | 42.9 | 66.7 | 56.3 |
| Total | 16 | 19 | 35 | 7 | 11 | 18 | 43.8 | 57.9 | 51.4 |
| R distal MC-2 | 10 | 9 | 19 | 1 | 1 | 2 | 10.0 | 11.1 | 10.5 |
| L distal MC-2 | 7 | 8 | 15 | 1 | 0 | 1 | 14.3 | 0.0 | 6.7 |
| Total | 17 | 17 | 34 | 2 | 1 | 3 | 11.8 | 5.9 | 8.8 |
| R proximal MC-3 | 9 | 11 | 20 | 2 | 5 | 7 | 22.2 | 45.5 | 35.0 |
| L proximal MC-3 | 5 | 9 | 14 | 3 | 5 | 8 | 60.0 | 55.5 | 57.1 |
| Total | 14 | 20 | 34 | 5 | 10 | 15 | 35.7 | 50.0 | 44.1 |
| R distal MC-3 | 8 | 11 | 19 | 1 | 1 | 2 | 12.5 | 9.1 | 10.5 |
| L distal MC-3 | 5 | 6 | 11 | 1 | 0 | 1 | 20.0 | 0.0 | 9.1 |
| Total | 13 | 17 | 30 | 2 | 1 | 3 | 15.4 | 5.9 | 10.0 |
| R proximal MC-4 | 10 | 10 | 20 | 4 | 6 | 10 | 40.0 | 60.0 | 50.0 |
| L proximal MC-4 | 5 | 10 | 15 | 3 | 6 | 9 | 60.0 | 60.0 | 60.0 |
| Total | 15 | 20 | 35 | 7 | 12 | 19 | 46.7 | 60.0 | 54.3 |
| R distal MC-4 | 10 | 10 | 20 | 1 | 0 | 1 | 10.0 | 0.0 | 5.0 |
| L distal MC-4 | 5 | 7 | 12 | 1 | 0 | 1 | 20.0 | 0.0 | 8.3 |
| Total | 15 | 17 | 32 | 2 | 0 | 2 | 13.3 | 0.0 | 6.3 |
| R proximal MC-5 | 10 | 9 | 19 | 5 | 6 | 11 | 50.0 | 66.7 | 57.9 |
| L proximal MC-5 | 4 | 9 | 13 | 3 | 5 | 8 | 75.0 | 55.6 | 61.5 |
| Total | 14 | 18 | 32 | 8 | 11 | 19 | 57.1 | 61.1 | 59.4 |
| R distal MC-5 | 10 | 9 | 19 | 1 | 1 | 2 | 10.0 | 11.1 | 10.5 |
| L distal MC-5 | 4 | 5 | 9 | 1 | 0 | 1 | 25.0 | 0.0 | 11.1 |
| Total | 14 | 14 | 28 | 2 | 1 | 3 | 14.3 | 7.1 | 10.7 |

TABLE 35

## FREQUENCY OF OCCURRENCE OF ALL ARTHRITIC INVOLVEMENT OCCURRING AT THE ANKLE

| ARTICULAR SURFACE |  | n |  |  | NUMBER |  |  | % |  |
|---|---|---|---|---|---|---|---|---|---|
|  | M | F | T | M | F | T | M | F | TOTAL |
| R distal tibia | 9 | 3 | 12 | 5 | 1 | 6 | 55.6 | 33.3 | 50.0 |
| L distal tibia | 5 | 3 | 8 | 3 | 0 | 3 | 60.0 | 0.0 | 37.5 |
| Total | 14 | 6 | 20 | 8 | 1 | 9 | 57.1 | 16.7 | 45.0 |
| R distal fibula | 7 | 5 | 12 | 3 | 3 | 6 | 42.9 | 60.0 | 50.0 |
| L distal fibula | 7 | 3 | 10 | 2 | 2 | 4 | 28.6 | 66.7 | 40.0 |
| Total | 14 | 8 | 22 | 5 | 5 | 10 | 35.7 | 62.5 | 45.5 |
| R T-F, talus | 11 | 5 | 16 | 2 | 2 | 4 | 18.2 | 40.0 | 25.0 |
| L T-F, talus | 12 | 6 | 18 | 3 | 3 | 6 | 25.0 | 50.0 | 33.3 |
| Total | 23 | 11 | 34 | 5 | 5 | 10 | 21.7 | 45.5 | 29.4 |
| R talus, head | 11 | 5 | 16 | 2 | 4 | 6 | 18.2 | 80.0 | 36.5 |
| L talus, head | 11 | 6 | 17 | 6 | 4 | 10 | 54.5 | 66.7 | 58.8 |
| Total | 22 | 11 | 33 | 8 | 8 | 16 | 36.4 | 72.7 | 48.5 |
| R talus, inf. | 12 | 4 | 16 | 8 | 4 | 12 | 67.3 | 100.0 | 75.0 |
| L talus, inf. | 12 | 6 | 18 | 8 | 4 | 12 | 66.7 | 66.7 | 66.7 |
| Total | 24 | 10 | 34 | 16 | 8 | 24 | 66.7 | 80.0 | 70.6 |
| R calcaneus | 12 | 7 | 19 | 9 | 5 | 14 | 75.0 | 71.4 | 73.7 |
| L calcaneus | 11 | 4 | 15 | 8 | 3 | 11 | 72.7 | 75.0 | 73.3 |
| Total | 23 | 11 | 34 | 17 | 8 | 25 | 73.9 | 72.7 | 73.5 |
| R navicular | 13 | 6 | 19 | 7 | 4 | 11 | 53.8 | 66.7 | 57.9 |
| L navicular | 12 | 6 | 18 | 9 | 3 | 12 | 75.0 | 50.0 | 66.7 |
| Total | 25 | 12 | 37 | 16 | 7 | 23 | 64.0 | 58.3 | 62.2 |
| R cuboid | 13 | 3 | 16 | 8 | 3 | 11 | 61.5 | 100.0 | 68.8 |
| L cuboid | 11 | 4 | 15 | 8 | 3 | 11 | 72.7 | 75.0 | 73.3 |
| Total | 24 | 7 | 31 | 16 | 6 | 22 | 66.7 | 85.7 | 71.0 |
| R cuneiform-1 | 8 | 3 | 11 | 4 | 2 | 6 | 50.0 | 66.7 | 54.5 |
| L cuneiform-1 | 11 | 5 | 16 | 6 | 2 | 8 | 54.5 | 40.0 | 50.0 |
| Total | 19 | 8 | 27 | 10 | 4 | 14 | 52.6 | 50.0 | 51.9 |
| R cuneiform-2 | 11 | 4 | 15 | 4 | 2 | 6 | 36.4 | 50.0 | 40.0 |
| L cuneiform-2 | 13 | 7 | 20 | 6 | 2 | 8 | 46.2 | 28.6 | 40.0 |
| Total | 24 | 11 | 35 | 10 | 4 | 14 | 41.7 | 36.4 | 40.0 |
| R cuneiform-3 | 9 | 5 | 14 | 3 | 2 | 5 | 33.3 | 40.0 | 35.7 |
| L cuneiform-3 | 11 | 5 | 16 | 7 | 2 | 9 | 63.6 | 40.0 | 56.3 |
| Total | 20 | 10 | 30 | 10 | 4 | 14 | 50.0 | 40.0 | 46.7 |

## TABLE 36

## FREQUENCY OF OCCURRENCE OF ALL ARTHRITIC CHANGES AT THE PROXIMAL AND DISTAL EXTREMITIES OF THE METATARSALS ACCORDING TO SEX

| ARTICULAR SURFACE | *n* | | | NUMBER | | | % | | |
|---|---|---|---|---|---|---|---|---|---|
| | M | F | T | M | F | T | M | F | TOTAL |
| R proximal MT-1 | 9 | 6 | 15 | 5 | 2 | 7 | 55.6 | 33.3 | 46.7 |
| L proximal MT-1 | 13 | 5 | 18 | 7 | 3 | 10 | 53.8 | 60.0 | 55.6 |
| Total | 22 | 11 | 33 | 12 | 5 | 17 | 54.5 | 45.5 | 51.5 |
| R distal MT-1 | 9 | 6 | 15 | 0 | 2 | 2 | 0.0 | 33.3 | 13.3 |
| L distal MT-1 | 13 | 6 | 19 | 2 | 1 | 3 | 15.4 | 16.7 | 15.8 |
| Total | 22 | 12 | 34 | 2 | 3 | 5 | 9.1 | 25.0 | 14.7 |
| R proximal MT-2 | 10 | 4 | 14 | 3 | 2 | 5 | 30.0 | 50.0 | 35.7 |
| L proximal MT-2 | 10 | 7 | 17 | 6 | 2 | 8 | 60.0 | 28.6 | 47.1 |
| Total | 20 | 11 | 31 | 9 | 4 | 13 | 45.0 | 36.4 | 41.9 |
| R distal MT-2 | 8 | 3 | 11 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| L distal MT-2 | 11 | 5 | 16 | 1 | 1 | 2 | 9.1 | 20.0 | 12.5 |
| Total | 19 | 8 | 27 | 1 | 1 | 2 | 5.3 | 12.5 | 7.4 |
| R proximal MT-3 | 8 | 5 | 13 | 2 | 2 | 4 | 25.0 | 40.0 | 30.8 |
| L proximal MT-3 | 10 | 6 | 16 | 4 | 2 | 6 | 40.0 | 33.3 | 37.5 |
| Total | 18 | 11 | 29 | 6 | 4 | 10 | 33.3 | 36.4 | 34.5 |
| R distal MT-3 | 6 | 5 | 11 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| L distal MT-3 | 6 | 4 | 10 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| Total | 12 | 9 | 21 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| R proximal MT-4 | 9 | 7 | 16 | 4 | 2 | 6 | 44.4 | 28.6 | 37.5 |
| L proximal MT-4 | 12 | 7 | 19 | 5 | 2 | 7 | 41.7 | 28.6 | 36.8 |
| Total | 21 | 14 | 35 | 9 | 4 | 13 | 42.9 | 28.6 | 37.1 |
| R distal MT-4 | 8 | 7 | 15 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| L distal MT-4 | 12 | 6 | 18 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| Total | 20 | 13 | 33 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| R proximal MT-5 | 10 | 5 | 15 | 4 | 1 | 5 | 40.0 | 20.0 | 33.3 |
| L proximal MT-5 | 12 | 6 | 18 | 5 | 2 | 7 | 41.7 | 33.3 | 38.9 |
| Total | 22 | 11 | 33 | 9 | 3 | 12 | 40.9 | 27.3 | 36.4 |
| R distal MT-5 | 10 | 5 | 15 | 1 | 0 | 1 | 10.0 | 0.0 | 6.7 |
| L distal MT-5 | 12 | 4 | 16 | 2 | 0 | 2 | 16.7 | 0.0 | 12.5 |
| Total | 22 | 9 | 31 | 3 | 0 | 3 | 13.6 | 0.0 | 9.7 |

## TABLE 37

## FREQUENCY OF OCCURRENCE OF ALL ARTHRITIC CHANGES AT THE PROXIMAL AND DISTAL EXTREMITIES OF THE HAND AND FOOT PHALANGES ACCORDING TO SEX

| ARTICULAR SURFACE | *n* | | | NUMBER | | | PERCENTAGE | | |
|---|---|---|---|---|---|---|---|---|---|
| | M. | F. | T. | M. | F. | T. | M. | F. | T. |
| R Prox. MC-1, Prox. | 9 | 9 | — | 2 | 3 | — | 22.2 | 33.3 | — |
| L Prox. MC-1, Prox. | | 7 | — | | 2 | — | | 28.6 | — |
| Total | 9 | 16 | 25 | 2 | 5 | 7 | 11.1 | 31.3 | 28.0 |
| R Prox. MC-1, Dist. | 9 | 9 | — | 0 | 1 | 1 | 0.0 | 11.1 | — |
| L Prox. MC-1, Dist. | | 7 | — | | 0 | 0 | | 0.0 | — |
| Total | 9 | 16 | 25 | 0 | 1 | 1 | 0.0 | 6.3 | 4.0 |
| R Dist. MC-1, Prox. | 4 | 5 | — | 1 | 3 | — | 25.0 | 60.0 | — |
| L Dist. MC-1, Prox. | | 5 | — | | 4 | — | | 80.0 | — |
| Total | 4 | 10 | 14 | 1 | 7 | 8 | 25.0 | 70.0 | 57.1 |
| R Dist. MC-1, Dist. | 4 | 5 | — | 4 | 0 | — | 100.0 | 0.0 | — |
| L Dist. MC-1, Dist. | | 5 | — | | 0 | — | | 0.0 | — |
| Total | 4 | 10 | 14 | 4 | 0 | 4 | 100.0 | 0.0 | 28.5 |
| All hand phalanges | | | | | | | | | |
| Prox. Phal., Prox. | 57 | 58 | 115 | 7 | 6 | 13 | 12.3 | 10.3 | 11.3 |
| Prox. Phal., Dist. | 58 | 62 | 120 | 0 | 4 | 4 | 0.0 | 6.5 | 3.3 |
| Medial Phal., Prox. | 46 | 40 | 86 | 6 | 4 | 10 | 13.0 | 10.0 | 11.6 |
| Medial Phal., Dist. | 46 | 39 | 85 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| Dist. Phal., Prox. | 15 | 24 | 39 | 3 | 0 | 3 | 20.0 | 0.0 | 7.7 |
| Dist. Phal., Dist. | 16 | 24 | 40 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| R Prox. MT-1, Prox. | 5 | 3 | 8 | 3 | 1 | 4 | 60.0 | 33.3 | 50.0 |
| L Prox. MT-1, Prox. | 1 | 10 | 11 | 1 | 3 | 4 | 100.0 | 30.0 | 36.4 |
| Total | 6 | 13 | 19 | 4 | 4 | 8 | 66.7 | 30.8 | 42.1 |
| R Prox. MT-1, Dist. | 4 | 4 | 8 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| L Prox. MT-1, Dist. | 0 | 10 | 10 | 0 | 2 | 2 | 0.0 | 20.0 | 20.0 |
| Total | 4 | 14 | 18 | 0 | 2 | 2 | 0.0 | 14.3 | 11.1 |
| R Dist. MT-1, Prox. | 4 | 1 | 5 | 2 | 1 | 3 | 50.0 | 100.0 | 60.0 |
| L Dist. MT-1, Prox. | 1 | 5 | 6 | 1 | 4 | 5 | 100.0 | 80.0 | 83.3 |
| Total | 5 | 6 | 11 | 3 | 5 | 8 | 60.0 | 83.3 | 72.7 |
| R Dist. MT-1, Dist. | 3 | 1 | 4 | 0 | 1 | 1 | 0.0 | 100.0 | 25.0 |
| L Dist. MT-1, Dist. | 1 | 5 | 6 | 0 | 2 | 2 | 0.0 | 40.0 | 33.3 |
| Total | 4 | 6 | 10 | 0 | 3 | 3 | 0.0 | 50.0 | 30.0 |
| All foot phalanges | | | | | | | | | |
| Prox. Phal., Prox. | 26 | 45 | 71 | 4 | 13 | 17 | 15.4 | 28.9 | 23.9 |
| Prox. Phal., Dist. | 27 | 44 | 71 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| Medial Phal., Prox. | 15 | 20 | 35 | 5 | 0 | 5 | 33.3 | 0.0 | 14.3 |
| Medial Phal., Dist. | 15 | 20 | 35 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| Dist. Phal., Prox. | 7 | 9 | 16 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| Dist. Phal., Dist. | 7 | 9 | 16 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |

## TABLE 38

### FREQUENCY OF OCCURRENCE OF ARTHRITIC INVOLVEMENT ON VERTEBRAL BODIES

| SURFACE | *n* | | | NUMBER | | | PERCENTAGE | | |
|---|---|---|---|---|---|---|---|---|---|
| | M. | F. | T. | M. | F. | T. | M. | F. | T. |
| C-2, Inferior | 15 | 8 | 23 | 0 | 1 | 1 | 0.0 | 12.5 | 4.3 |
| C-3, Superior | 14 | 9 | 23 | 3 | 1 | 4 | 21.4 | 11.1 | 17.4 |
| C-3, Inferior | 14 | 9 | 23 | 5 | 1 | 6 | 35.7 | 11.1 | 26.1 |
| C-4, Superior | 15 | 8 | 23 | 4 | 2 | 6 | 26.7 | 25.0 | 26.1 |
| C-4, Inferior | 15 | 8 | 23 | 2 | 2 | 4 | 13.3 | 25.0 | 17.4 |
| C-5, Superior | 13 | 9 | 22 | 4 | 1 | 5 | 30.8 | 11.1 | 22.7 |
| C-5, Inferior | 13 | 9 | 22 | 4 | 1 | 5 | 30.8 | 11.1 | 22.7 |
| C-6, Superior | 11 | 8 | 19 | 3 | 1 | 4 | 27.3 | 12.5 | 21.1 |
| C-6, Inferior | 13 | 8 | 21 | 6 | 1 | 7 | 53.8 | 12.5 | 33.3 |
| C-7, Superior | 14 | 6 | 20 | 5 | 1 | 6 | 35.7 | 16.7 | 30.0 |
| C-7, Inferior | 14 | 7 | 21 | 2 | 1 | 3 | 14.3 | 14.3 | 14.3 |
| All Cerv., Superior | 84 | 49 | 133 | 19 | 6 | 25 | 22.6 | 12.2 | 18.8 |
| All Cerv., Inferior | 67 | 40 | 107 | 19 | 7 | 26 | 28.4 | 17.5 | 24.3 |
| T-1, Superior | 15 | 4 | 19 | 4 | 0 | 4 | 26.7 | 0.0 | 21.1 |
| T-1, Inferior | 14 | 4 | 18 | 1 | 0 | 1 | 7.1 | 0.0 | 5.6 |
| T-2, Superior | 13 | 5 | 18 | 3 | 0 | 3 | 23.1 | 0.0 | 16.7 |
| T-2, Inferior | 13 | 5 | 18 | 2 | 0 | 2 | 15.4 | 0.0 | 11.1 |
| T-3, Superior | 11 | 5 | 16 | 6 | 0 | 6 | 54.5 | 0.0 | 37.5 |
| T-3, Inferior | 11 | 5 | 16 | 2 | 0 | 2 | 18.2 | 0.0 | 12.5 |
| T-4, Superior | 12 | 6 | 18 | 3 | 1 | 4 | 25.0 | 16.7 | 22.2 |
| T-4, Inferior | 12 | 6 | 18 | 1 | 1 | 2 | 8.3 | 16.7 | 11.1 |
| T-5, Superior | 10 | 7 | 17 | 2 | 1 | 3 | 20.0 | 14.3 | 17.6 |
| T-5, Inferior | 10 | 7 | 17 | 2 | 0 | 2 | 20.0 | 0.0 | 11.8 |
| T-6, Superior | 12 | 5 | 17 | 2 | 1 | 3 | 16.7 | 20.0 | 17.6 |
| T-6, Inferior | 13 | 5 | 18 | 3 | 0 | 3 | 23.1 | 0.0 | 16.7 |
| T-7, Superior | 13 | 5 | 18 | 3 | 1 | 4 | 23.1 | 20.0 | 22.2 |
| T-7, Inferior | 13 | 5 | 18 | 3 | 1 | 4 | 23.1 | 20.0 | 22.2 |
| T-8, Superior | 10 | 6 | 16 | 4 | 2 | 6 | 40.0 | 33.3 | 37.5 |
| T-8, Inferior | 11 | 6 | 17 | 3 | 2 | 5 | 27.3 | 33.3 | 29.4 |
| T-9, Superior | 12 | 6 | 18 | 3 | 1 | 4 | 25.0 | 16.7 | 22.2 |
| T-9, Inferior | 12 | 6 | 18 | 2 | 1 | 3 | 16.7 | 16.7 | 16.7 |
| T-10, Superior | 10 | 6 | 16 | 3 | 0 | 3 | 30.0 | 0.0 | 18.8 |
| T-10, Inferior | 10 | 6 | 16 | 2 | 0 | 2 | 20.0 | 0.0 | 12.5 |
| T-11, Superior | 10 | 6 | 16 | 1 | 0 | 1 | 10.0 | 0.0 | 6.3 |
| T-11, Inferior | 10 | 6 | 16 | 1 | 0 | 1 | 10.0 | 0.0 | 6.3 |
| T-12, Superior | 10 | 6 | 16 | 1 | 0 | 1 | 10.0 | 0.0 | 6.3 |
| T-12, Inferior | 10 | 5 | 15 | 1 | 0 | 1 | 10.0 | 0.0 | 6.7 |
| All Thor., Superior | 138 | 67 | 205 | 35 | 7 | 42 | 25.4 | 10.4 | 20.5 |
| All Thor., Inferior | 138 | 66 | 204 | 23 | 5 | 28 | 16.7 | 7.6 | 13.7 |
| L-1, Superior | 10 | 8 | 18 | 1 | 1 | 2 | 10.0 | 12.5 | 11.1 |
| L-1, Inferior | 10 | 7 | 17 | 1 | 2 | 3 | 10.0 | 28.6 | 17.6 |
| L-2, Superior | 8 | 4 | 12 | 2 | 2 | 4 | 25.0 | 50.0 | 33.3 |
| L-2, Inferior | 8 | 4 | 12 | 2 | 1 | 3 | 25.0 | 25.0 | 25.0 |
| L-3, Superior | 6 | 3 | 9 | 4 | 1 | 5 | 66.7 | 33.3 | 55.6 |
| L-3, Inferior | 7 | 3 | 10 | 4 | 1 | 5 | 57.1 | 33.3 | 50.0 |
| L-4, Superior | 6 | 5 | 11 | 4 | 1 | 5 | 66.7 | 20.0 | 45.5 |
| L-4, Inferior | 5 | 5 | 10 | 3 | 1 | 4 | 60.0 | 20.0 | 40.0 |
| L-5, Superior | 6 | 6 | 12 | 3 | 2 | 5 | 50.0 | 33.3 | 41.7 |
| L-5, Inferior | 6 | 6 | 12 | 3 | 3 | 6 | 50.0 | 50.0 | 50.0 |
| All Lumbar, Superior | 36 | 26 | 62 | 14 | 7 | 21 | 38.9 | 26.9 | 33.9 |
| All Lumbar, Inferior | 36 | 25 | 61 | 13 | 8 | 21 | 36.1 | 32.0 | 34.4 |

## TABLE 39

## FREQUENCY OF OCCURRENCE OF ALL ARTHRITIC INVOLVEMENT ON THE ARTICULAR SURFACES OF THE CERVICAL VERTEBRAE

| ARTICULAR SURFACE | *n* | | | NUMBER | | | PERCENTAGE | | |
|---|---|---|---|---|---|---|---|---|---|
| | M. | F. | T. | M. | F. | T. | M. | F. | T. |
| C-1, R Superior | 11 | 8 | 19 | 6 | 3 | 9 | 54.5 | 37.5 | 47.4 |
| C-1, R Inferior | 11 | 8 | 19 | 6 | 3 | 9 | 54.5 | 37.5 | 47.4 |
| C-1, L Superior | 13 | 7 | 20 | 6 | 3 | 9 | 46.2 | 42.9 | 45.0 |
| C-1, L Inferior | 13 | 7 | 20 | 6 | 3 | 9 | 46.2 | 42.9 | 45.0 |
| C-2, R Superior | 16 | 8 | 24 | 3 | 3 | 6 | 18.8 | 37.5 | 25.0 |
| C-2, R Inferior | 16 | 5 | 21 | 6 | 3 | 9 | 37.5 | 60.0 | 42.9 |
| C-2, L Superior | 15 | 8 | 23 | 3 | 3 | 6 | 20.0 | 37.5 | 26.1 |
| C-2, L Inferior | 15 | 5 | 20 | 2 | 1 | 3 | 13.3 | 20.0 | 15.0 |
| C-3, R Superior | 14 | 8 | 22 | 2 | 0 | 2 | 14.3 | 0.0 | 9.1 |
| C-3, R Inferior | 14 | 8 | 22 | 3 | 0 | 3 | 21.4 | 0.0 | 13.6 |
| C-3, L Superior | 13 | 6 | 19 | 2 | 0 | 2 | 15.4 | 0.0 | 10.5 |
| C-3, L Inferior | 13 | 6 | 19 | 2 | 0 | 2 | 15.4 | 0.0 | 10.5 |
| C-4, R Superior | 14 | 9 | 23 | 1 | 0 | 1 | 7.1 | 0.0 | 4.3 |
| C-4, R Inferior | 14 | 9 | 23 | 3 | 0 | 3 | 21.4 | 0.0 | 13.0 |
| C-4, L Superior | 13 | 9 | 22 | 3 | 0 | 3 | 23.1 | 0.0 | 13.6 |
| C-4, L Inferior | 13 | 9 | 22 | 3 | 0 | 3 | 23.1 | 0.0 | 13.6 |
| C-5, R Superior | 12 | 9 | 21 | 4 | 1 | 5 | 33.3 | 11.1 | 23.8 |
| C-5, R Inferior | 11 | 8 | 19 | 2 | 0 | 2 | 18.2 | 0.0 | 10.5 |
| C-5, L Superior | 11 | 9 | 20 | 2 | 0 | 2 | 18.2 | 0.0 | 10.0 |
| C-5, L Inferior | 11 | 9 | 20 | 2 | 0 | 2 | 18.2 | 0.0 | 10.0 |
| C-6, R Superior | 12 | 8 | 20 | 1 | 0 | 1 | 8.3 | 0.0 | 5.0 |
| C-6, R Inferior | 11 | 8 | 19 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| C-6, L Superior | 11 | 8 | 19 | 1 | 0 | 1 | 9.1 | 0.0 | 5.3 |
| C-6, L Inferior | 10 | 8 | 18 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| C-7, R Superior | 13 | 8 | 21 | 1 | 0 | 1 | 7.7 | 0.0 | 4.8 |
| C-7, R Inferior | 14 | 8 | 22 | 1 | 0 | 1 | 7.1 | 0.0 | 4.5 |
| C-7, L Superior | 13 | 6 | 19 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| C-7, L Inferior | 14 | 6 | 20 | 1 | 0 | 1 | 7.1 | 0.0 | 5.0 |
| All cervical | | | | | | | | | |
| R Superior | 92 | 58 | 150 | 18 | 7 | 25 | 19.6 | 12.1 | 16.7 |
| R Inferior | 94 | 54 | 148 | 18 | 4 | 22 | 19.1 | 7.4 | 14.9 |
| L Superior | 89 | 53 | 142 | 17 | 6 | 23 | 19.1 | 11.3 | 16.2 |
| L Inferior | 78 | 41 | 119 | 14 | 4 | 18 | 17.9 | 9.8 | 15.1 |

## TABLE 40

## FREQUENCY OF OCCURRENCE OF ALL ARTHRITIC INVOLVEMENT ON THE ARTICULAR SURFACES OF THE THORACIC VERTEBRAE

| ARTICULAR SURFACE | *n* | | | NUMBER | | | PERCENTAGE | | |
|---|---|---|---|---|---|---|---|---|---|
| | M. | F. | T. | M. | F. | T. | M. | F. | T. |
| T-1, R Superior | 14 | 6 | 20 | 0 | 1 | 1 | 0.0 | 16.7 | 5.0 |
| T-1, R Inferior | 14 | 6 | 20 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| T-1, L Superior | 14 | 6 | 20 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| T-1, L Inferior | 14 | 6 | 20 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| T-2, R Superior | 14 | 6 | 20 | 1 | 0 | 1 | 7.1 | 0.0 | 5.0 |
| T-2, R Inferior | 15 | 6 | 21 | 1 | 0 | 1 | 6.7 | 0.0 | 4.8 |
| T-2, L Superior | 15 | 5 | 20 | 1 | 0 | 1 | 6.7 | 0.0 | 5.0 |
| T-2, L Inferior | 15 | 5 | 20 | 1 | 0 | 1 | 6.7 | 0.0 | 5.0 |
| T-3, R Superior | 14 | 5 | 19 | 1 | 1 | 2 | 7.1 | 20.0 | 10.5 |
| T-3, R Inferior | 14 | 5 | 19 | 1 | 1 | 2 | 7.1 | 20.0 | 10.5 |
| T-3, L Superior | 14 | 5 | 19 | 1 | 1 | 2 | 7.1 | 20.0 | 10.5 |
| T-3, L Inferior | 14 | 5 | 19 | 1 | 1 | 2 | 7.1 | 20.0 | 10.5 |
| T-4, R Superior | 15 | 5 | 20 | 1 | 1 | 2 | 6.7 | 20.0 | 10.0 |
| T-4, R Inferior | 12 | 8 | 20 | 0 | 1 | 1 | 0.0 | 12.5 | 5.0 |
| T-4, L Superior | 13 | 5 | 18 | 1 | 1 | 2 | 7.7 | 20.0 | 11.1 |
| T-4, L Inferior | 15 | 5 | 20 | 1 | 1 | 2 | 6.7 | 20.0 | 10.0 |
| T-5, R Superior | 11 | 8 | 19 | 0 | 1 | 1 | 0.0 | 12.5 | 5.3 |
| T-5, R Inferior | 13 | 8 | 21 | 0 | 1 | 1 | 0.0 | 12.5 | 4.8 |
| T-5, L Superior | 10 | 8 | 18 | 0 | 1 | 1 | 0.0 | 12.5 | 5.6 |
| T-5, L Inferior | 14 | 7 | 21 | 1 | 2 | 3 | 7.1 | 28.6 | 14.3 |
| T-6, R Superior | 14 | 6 | 20 | 2 | 2 | 4 | 14.3 | 33.3 | 20.0 |
| T-6, R Inferior | 14 | 7 | 21 | 1 | 2 | 3 | 7.1 | 28.6 | 14.3 |
| T-6, L Superior | 13 | 6 | 19 | 2 | 3 | 5 | 15.4 | 50.0 | 26.3 |
| T-6, L Inferior | 14 | 7 | 21 | 1 | 0 | 1 | 7.7 | 0.0 | 4.8 |
| T-7, R Superior | 14 | 5 | 19 | 1 | 1 | 2 | 7.1 | 20.0 | 10.5 |
| T-7, R Inferior | 14 | 6 | 20 | 1 | 2 | 3 | 7.1 | 33.3 | 15.0 |
| T-7, L Superior | 14 | 6 | 20 | 1 | 1 | 2 | 7.1 | 16.7 | 10.0 |
| T-7, L Inferior | 14 | 7 | 21 | 2 | 2 | 4 | 14.3 | 28.6 | 19.0 |
| T-8, R Superior | 12 | 4 | 16 | 1 | 1 | 2 | 8.3 | 25.0 | 12.5 |
| T-8, R Inferior | 11 | 5 | 16 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| T-8, L Superior | 11 | 4 | 15 | 0 | 1 | 1 | 0.0 | 25.0 | 6.7 |
| T-8, L Inferior | 12 | 5 | 17 | 0 | 3 | 3 | 0.0 | 60.0 | 17.6 |
| T-9, R Superior | 13 | 8 | 21 | 1 | 1 | 2 | 7.7 | 12.5 | 9.5 |
| T-9, R Inferior | 13 | 8 | 21 | 1 | 1 | 2 | 7.7 | 12.5 | 9.5 |
| T-9, L Superior | 12 | 7 | 19 | 1 | 1 | 2 | 8.3 | 14.3 | 10.5 |
| T-9, L Inferior | 11 | 7 | 18 | 0 | 2 | 2 | 0.0 | 28.6 | 11.1 |
| T-10, R Superior | 10 | 7 | 17 | 0 | 2 | 2 | 0.0 | 28.6 | 11.8 |
| T-10, R Inferior | 11 | 6 | 17 | 2 | 2 | 4 | 18.2 | 33.3 | 23.5 |
| T-10, L Superior | 10 | 6 | 16 | 0 | 2 | 2 | 0.0 | 33.3 | 12.5 |
| T-10, L Inferior | 11 | 6 | 17 | 2 | 2 | 4 | 18.2 | 33.3 | 23.5 |
| T-11, R Superior | 11 | 2 | 13 | 1 | 2 | 3 | 9.1 | 100.0 | 23.1 |
| T-11, R Inferior | 11 | 5 | 16 | 0 | 2 | 2 | 0.0 | 40.0 | 12.5 |
| T-11, L Superior | 11 | 6 | 17 | 1 | 2 | 3 | 9.1 | 33.3 | 17.6 |
| T-11, L Inferior | 11 | 6 | 17 | 0 | 2 | 2 | 0.0 | 33.3 | 11.8 |
| T-12, R Superior | 12 | 6 | 18 | 1 | 1 | 2 | 8.3 | 16.7 | 11.1 |
| T-12, R Inferior | 12 | 6 | 18 | 1 | 1 | 2 | 8.3 | 16.7 | 11.1 |
| T-12, L Superior | 12 | 5 | 17 | 1 | 1 | 2 | 8.3 | 20.0 | 11.8 |
| T-12, L Inferior | 9 | 6 | 15 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| All | | | | | | | | | |
| R Superior | 154 | 72 | 226 | 10 | 14 | 24 | 6.5 | 19.4 | 10.6 |
| R Inferior | 157 | 73 | 230 | 9 | 12 | 21 | 5.7 | 16.4 | 9.1 |
| L Superior | 149 | 69 | 218 | 9 | 14 | 23 | 6.0 | 20.3 | 10.6 |
| L Inferior | 166 | 80 | 246 | 9 | 15 | 24 | 5.4 | 18.8 | 9.8 |

## TABLE 41

## FREQUENCY OF OCCURRENCE OF ALL ARTHRITIC INVOLVEMENT ON THE LUMBAR ARTICULAR SURFACES

| ARTICULAR SURFACE | *n* | | | NUMBER | | | PERCENTAGE | | |
|---|---|---|---|---|---|---|---|---|---|
| | M. | F. | T. | M. | F. | T. | M. | F. | T. |
| L-1, R Superior | 13 | 7 | 20 | 0 | 1 | 1 | 0.0 | 14.3 | 5.0 |
| L-1, R Inferior | 12 | 7 | 19 | 0 | 3 | 3 | 0.0 | 42.9 | 15.7 |
| L-1, L Superior | 11 | 4 | 15 | 0 | 3 | 3 | 0.0 | 75.0 | 20.0 |
| L-1, L Inferior | 11 | 7 | 18 | 0 | 3 | 3 | 0.0 | 42.9 | 16.7 |
| L-2, R Superior | 10 | 6 | 16 | 0 | 2 | 2 | 0.0 | 33.3 | 12.5 |
| L-2, R Inferior | 9 | 5 | 14 | 0 | 1 | 1 | 0.0 | 20.0 | 7.1 |
| L-2, L Superior | 9 | 4 | 13 | 0 | 1 | 1 | 0.0 | 25.0 | 7.7 |
| L-2, L Inferior | 9 | 5 | 14 | 0 | 1 | 1 | 0.0 | 20.0 | 7.1 |
| L-3, R Superior | 9 | 5 | 14 | 0 | 2 | 2 | 0.0 | 40.0 | 14.3 |
| L-3, R Inferior | 8 | 5 | 13 | 0 | 1 | 1 | 0.0 | 20.0 | 7.7 |
| L-3, L Superior | 9 | 5 | 14 | 0 | 1 | 1 | 0.0 | 20.0 | 7.1 |
| L-3, L Inferior | 8 | 5 | 13 | 0 | 2 | 2 | 0.0 | 40.0 | 15.4 |
| L-4, R Superior | 6 | 5 | 11 | 1 | 2 | 3 | 16.7 | 40.0 | 27.3 |
| L-4, R Inferior | 6 | 4 | 10 | 1 | 2 | 3 | 16.7 | 50.0 | 30.0 |
| L-4, L Superior | 6 | 4 | 10 | 1 | 2 | 3 | 16.7 | 50.0 | 30.0 |
| L-4, L Inferior | 6 | 4 | 10 | 1 | 2 | 3 | 16.7 | 50.0 | 30.0 |
| L-5, R Superior | 6 | 6 | 12 | 2 | 3 | 5 | 33.3 | 50.0 | 41.7 |
| L-5, R Inferior | 6 | 6 | 12 | 1 | 2 | 3 | 16.7 | 33.3 | 25.0 |
| L-5, L Superior | 5 | 4 | 9 | 2 | 3 | 5 | 40.0 | 75.0 | 55.6 |
| L-5, L Inferior | 6 | 6 | 12 | 1 | 2 | 3 | 16.7 | 33.3 | 25.0 |
| All lumbar | | | | | | | | | |
| R Superior | 44 | 29 | 73 | 3 | 10 | 13 | 6.8 | 34.5 | 17.8 |
| R Inferior | 41 | 27 | 68 | 2 | 9 | 11 | 4.9 | 33.3 | 16.2 |
| L Superior | 40 | 21 | 61 | 3 | 10 | 13 | 7.5 | 47.6 | 21.3 |
| L Inferior | 40 | 27 | 67 | 2 | 10 | 12 | 5.0 | 37.0 | 17.9 |

## TABLE 42

## A COMPARISON OF LIVING (ca. 1920) AND PREHISTORIC TONGAN MEASUREMENTS

| | MALE | | | | | | FEMALE | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (SULLIVAN) | | | (PIETRUSEWSKY) | | | (SULLIVAN) | | | (PIETRUSEWSKY) | |
| MEASUREMENT INDEX | *n* | MEAN (92-117) | S.D. | *n* | MEAN | S.D. | *n* | MEAN (88-97) | S.D. | *n* | MEAN | S.D. |
| Head length | 117 | 191.0 | 6.9 | 13 | 183.1 | 7.9 | 97 | 184.1 | 6.47 | 5 | 172.6 | 4.2 |
| Head width | 117 | 154.8 | 4.3 | 12 | 143.0 | 10.0 | 97 | 150.0 | 5.1 | 4 | 133.5 | 7.4 |
| Cephalic index | 117 | 81.1 | 3.1 | 11 | 78.3 | 6.2 | 97 | 81.6 | 4.1 | 4 | 77.1 | 4.1 |
| Min. frontal diameter | 116 | 104.8 | 4.9 | 12 | 101.8 | 6.4 | 96 | 103.0 | 4.7 | 5 | 97.6 | 4.8 |
| Bizygomatic | 116 | 143.5 | 5.9 | 3 | 142.7 | 2.1 | 97 | 136.1 | 6.0 | 0 | — | — |
| Zygomatico-frontal index | 116 | 73.1 | 4.2 | 3 | 72.0 | 4.9 | 97 | 75.4 | 3.3 | 0 | — | — |
| Bigonial | 116 | 104.8 | 5.8 | 17 | 101.3 | 8.5 | 96 | 99.2 | 4.8 | 7 | 95.3 | 2.9 |
| Corrected measurements | | | | | | | | | | | | |
| Head length | 117 | 180.0 | 6.9 | 13 | 183.1 | 7.9 | 97 | 173.1 | 6.5 | 5 | 172.6 | 4.2 |
| Head width | 117 | 143.8 | 4.3 | 12 | 143.0 | 10.0 | 97 | 139.0 | 5.1 | 4 | 133.5 | 7.4 |
| Cephalic index | 117 | 79.9 | 3.1* | 11 | 78.3 | 6.2* | 97 | 80.3 | 4.1* | 4 | 77.1 | 4.1* |
| Min. frontal diameter | 116 | 98.8 | 4.9 | 12 | 101.8 | 6.4 | 96 | 95.0 | 4.7 | 5 | 97.6 | 4.8 |
| Bizygomatic | 116 | 131.4 | 5.9 | 3 | 142.7 | 2.1 | 97 | 124.0 | 6.0 | 0 | — | — |
| Zygomatico-frontal index | 116 | 75.2 | 4.2* | 3 | 72.0 | 4.9 | 97 | 76.6 | 3.3* | 0 | — | — |
| Bigonial | 116 | 80.6†<br>(94.8)** | 5.8 | 17 | 101.3 | 8.5 | 96 | 75.0†<br>(89.2)** | 4.8 | 7 | 95.3 | 2.9 |

* approximate estimate of S.D.

† probably too low as measurement was taken differently by Sullivan

** a more reasonable estimate

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